ARCHIVES

OF

USEFUL KNOWLEDGE.

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BANK OF INDUSTRY.

ONE of the first duties of a great city, is to apply the remedies that may be in its power, to the evils necessarily arising from its own extensive population. It is incident to any such mass of population, to concentre within itself, not only the idle and the vitious from all the country, but a great class of improvident people, who are honest and willing to earn their living, but who do not readily see the means of saving what they earn. This class of people often fall into distress for want of some easy and familiar method of placing their surplus earnings, at one season, in such a situation as to be safe and always within their reach in times of need. What is not immediately necessary to their comfort, they squander in useless and perhaps vitious gratifications, creating factitious wants, and inducing habits of idleness, which lead to misery, then to crimes, and finally to punishment; augmenting the poor-rates, rendering property insecure, and thus multiplying the evils, and diminishing the benefits of a dense population.

Let us suppose a case to which I make a direct reference. A servant receives 20 dollars for wages due. He is well disposed, and if he knew of any mode of placing it where it would be safe and productive, he would not only lay up the greater part of this sum, but he would be adding to it every month, till with its interest it would amount to a considerable sum, and enable him to

rear and educate a family. But for want of such facility, he will not probably have a dollar left at the end of the month. Some new article of dress or ornament, the theatre, or a worse gulph has absorbed all. The case here referred to, is but one instance out of thousands in this city, among journeymen, labourers, men-servants and women-servants; useful classes of people, who compose a considerable portion of the population of every great town, all of whom receive more wages than are necessary to their real or customary wants.*

These evils, like many others usually neglected, are not without an obvious remedy. Let the Treasurer of the Corporation be the banker, and let there be a clerk allowed him to attend to the particular duty of the Chest of Savings. Let him receive and book every sum that is offered, not less than one sixteenth of a dollar; and give a bank-book, to be made at the expense of the Corporation, to every person who shall have deposited to the amount of ten dollars, in which may be entered by the clerk each sum deposited or drawn out. Every credit of five dollars and upwards should entitle the creditor to an interest, at the rate of five per cent. per annum, for any period over sixty days. Credits in the CHEST OF SAVINGS may be transferred at the office with the same formalities as bank shares, but no sum less than fifty dollars should be transferable except by death. A creditor might be permitted to demand and receive, at all times within office hours, any part, or the whole of the sum due him, without any other formalities except that of presenting his book, and having it entered therein by the clerk, provided that no smaller sum than *one dollar* be drawn out at a time, unless a smaller sum be the whole balance due.

The public advantages that must arise from the plan are extremely obvious: as, 1. There is no surer shield that can be devised to the morals of the labouring and poorer class of people. 2. It would save them in a great measure from tippling, gamb-

* The wages of servants are from 8 to 16 dollars per month. Coachmen (a numerous class) have the latter sum, and many of them 20, and more, dollars, per month; but in the latter case they board themselves.

ling, and other modes of dissipation and idleness. 3. It would probably save to this city 50,000 dollars a year in poor-rates. 4. It would serve as an example to other cities, and possibly it might lead to other reforms in public discipline, education, and police, on which few persons have reflected, but which are still wanting in the progress of civilization.

I do not pretend to the entire originality of this plan, and probably it may tend to enforce the propriety of adopting it, to inform that such a bank was instituted by the famous Mirabeau, and established by law in Paris, in the commencement of the French Revolution; the movers of which, amid all their projects of ambition and political aggrandizement, have never lost sight of every measure that could in the least tend to add to the resources of the nation, to give employment to the people, or diminish the unavoidable evils of their military government. The bank is called in English, the "*Bank of Savings*," and is at this day in full operation, and I have understood has been productive of the greatest advantages. It is also similar in its operation and effect to "*Benefit Societies*,"* which are very general in England, where they have been found to diminish the enormous poor taxes, under which that country groans, more than any legal or general regulation which has yet been attempted; and are spoken of in the warmest terms of commendation, by the well-informed writers on political economy who have appeared since their institution. If necessary, numerous authorities might be referred to in proof.

The above are merely the general outlines of the plan: much more might be said on the advantages which would result from its general adoption in every great capital: the minor details of its arrangement would be suggested to every intelligent officer acquainted with accounts, and are therefore deemed unessential in this place.

* These Benefit Societies are associations of the labouring people, or all orders of mechanics, who appropriate some small part of their earnings to a fund from which they may draw succour in the hour of need. The mechanics of several branches in Philadelphia have such associations, and I have understood from some of the members, that very great advantages have been derived from them.

ON THE

MANUFACTURE OF SAIL-CLOTH.

THE manufacture of canvas is an object of the greatest importance to a commercial nation; its *quality* ought to be the first, its *price* only of secondary consideration.

It may appear strange, but it is true, that this article of indispensable necessity to the British navy, on which depends in so great a degree, the safety of the fleet and the empire, is now vastly inferior in *quality*, to what it was thirty or forty years ago.

While in their dock-yards, the greatest attention is bestowed on the quality and seasoning of the oak, none at all is thought necessary to the canvas, although of equal importance to the safety of the ship, and the lives of the sailors.

The very rules and regulations issued by the navy board for the manufacture of government canvas are defective; and it is impossible, according to those rules, to produce a good quality; however, it does not seem to be the aim of the board to obtain the *first* fabric, they are content with a humble mediocrity, that the owner of a fishing smack would despise.

The inferiority of government canvas cannot be attributed to the manufacturers, for they make it according to their *instructions;* but to the mistaken policy of the navy board, who limit the price, and of course the quality—who imagine that canvas of a *certain* rate is sufficient for the purpose, and have no wish that it should be of a better quality, because then, it would be *too good for the use.* Thus, trifling with the great interests of the nation, as though his majesty's ships and the lives of his brave seamen, were of less importance than a revenue cutter or a Bridport smack; neither of which would use such canvas as government receives, although it were afforded to them for nothing.

The professed reason for ordering this middle sort of canvas is, that it can be obtained at a *middle* price; it is neither the high-

est nor the lowest that the country produces, but it is thought good enough for a man of war. It is, however, a common observation, and perhaps a true one, that the highest priced manufactured commodities are generally the cheapest in the end. Being made of better materials and more labour bestowed on their finishing, they compensate the purchaser by long service, as well as their superior fitness for the purpose intended.

Government canvas is made of a warp or chain of flax yarn, weighing about 20 lbs. laid double, the woof or shute is of hemp yarn drove on single, weighing about 24 lbs. Both warp and woof yarn are once boiled in an alkaline ley, and suffer a waste of about 7 per cent., which is again recovered by the application of starch to the chain, and the bolt when finished, for a No. 1, weighs 44 lbs.

Bridport canvas, which is the best in the kingdom, is made wholly of flax yarn, boiled in alkaline salts and bleached by grassing, by which operations it suffers a loss of about 25 per cent.

To ascertain the difference of value to the consumer, between these two kinds of canvas, it is only necessary to observe, that the great defect of all canvas, is its aptitude to *mildew*, from its alternate exposure to warm and cold, dry and wet weather. Mildew, is the first perceptible symptom of fermentation to which all vegetable substances are liable, and its progress will be rapid or slow, in proportion to the quantity of *mucus* they contain. The fermentation of all vegetable and animal substances induces new compounds, and consequently separates their component parts; hence their gradual decay, and at last, their final dissolution.

On this principle we may determine the superiority of Bridport canvas. It is cleansed by alkaline salts, and the process of bleaching to a loss of 25 per cent., and we may reasonably conclude that the mucus is altogether removed, or nearly so. It will not therefore be so apt to mildew as government canvas, which is only cleansed to a loss of 7 per cent.

The difference of price between Bridport and government sail-cloth is 6*d.* or 8*d.* per yard; and what does this paltry saving signify to a great nation, compared with the consequences that may

result from the use of an article on which so much depends, as the lives of brave men?

The following remarks on this interesting subject by the Earl of Dundonald, are well worth the attention of the Manufacturer. The name of this nobleman stands high among the improvers of the manufactures of his country, and Britain owes much to his inventive genius, and to his application of the principles of science to the useful arts.

Report on the Method of Manufacturing, and the Properties of Dutch, Danish, Bridport, and British Navy Sail-Cloth. By the Earl of Dundonald.

Lord Dundonald duly received the samples of Dutch and Danish canvas, which Captain Johnson Hope had sent for his inspection. He has minutely examined and analyzed them, and subjoins his report as to their fabric and degrees of cleansing, which the yarn, of which they had been manufactured, had been made to undergo previously to the operation of weaving. Likewise his report of four bolts of canvas, viz. Nos. 1, 2, 3, and 4, made according to his directions, by Messrs. Fowler & Son, of Bridport, samples of which accompany this. Messrs. Fowler's would have been preferable in quality to any Holland duck, had it been made of hemp instead of flax, and wove with two and a half or three more scores in the reed. Messrs. Fowler not having any thoroughly well boiled, grassed, and bleached hemp yarn at the time the order was given, were under the necessity of substituting the flax yarn employed by them in the manufacture of canvas, likewise employed by all the manufacturers of sail-cloth at Bridport, Crewkerne, and in the south-west of England; from which places all the revenue vessels, packet boats, and smacks of Great-Britain and Ireland, are exclusively supplied with canvas for their sails. The Bridport and Crewkerne canvas does not mildew, and does considerably more than outlast two suits of sails made of such canvas as the British navy is at present, and has for upwards of thirty years been supplied with. The Bridport, &c. &c. canvas stands its number to the last, without any loss in weight further than shall happen from friction; because the yarn

of which the Bridport had been wove, had been repeatedly and thoroughly boiled with alkaline salts, grassed, bleached during some weeks, and fully divested of all soluble extractive matter, capable of being washed out by the rains. Besides which, Bridport, &c. canvas, is wove with little or no wheaten flour dressing, which is likewise soluble, and removed at last by the conjunct action of rain and weather.

While these two soluble substances remain in the canvas, it will to a certainty mildew in damp hot weather. But say that the canvas had not mildewed (the weather being supposed cold and rainy); the rain will wash out the two soluble extractive matters, whereby the canvas becomes open between the threads, like a biscuit bag, incapable of holding or containing the wind. Lord Dundonald has proved this to be the case on fifty or sixty trials made with navy canvas. No 1, the canvas proper for ships lower sails, has uniformly been reduced by two boilings to the weight of a No. 4, the number proper for a topgallant sail; sometimes to the weight of a No. 5, which corresponds to a loss in weight of 20 per cent.

It is obvious that the soluble extractive matter of the flax or hemp, and the weaten flour paste dressing, cannot add to the strength of the yarn, of which the canvas had been wove.

The soluble matter only serves for a time to fill up the space between the threads. To mislead the eye as to the quality of the canvas, and to add to its weight, so as to make it correspond to the regulations of the Navy Board, which requires that canvas

	lbs.
No. 1, should weigh per bolt,	44
— 2,	41
— 3,	38
— 4,	35

Lord Dundonald has already stated, that navy canvas, No. 1, had been reduced by him by two boilings with a solution of alkaline salts to the weight of a No. 4, which corresponded to a loss in weight of a fifth, or 20 per cent.; and with such canvas the British navy is at present, and has for these thirty years been supplied. It is impossible to conceive why the British navy is supplied

with a sort of canvas which is uniformly rejected by the revenue cruisers; as if it was an object of less importance to capture an enemy than to catch a smuggler; or, as if the safety of the revenue vessels and their crews were of more importance than the safety of the British navy, and the lives of the gallant seamen, who man their fleets and fight the battles of their country. The highest degree of blame is to be attached to the conduct of the Navy Boards during these thirty years past, and to whom, unfortunately for the navy, the sole power of regulating the method of manufacture, as well as the price, has been entrusted. The price for these thirty years past has been so low, that it was impossible a manufacturer could, without a certain loss, employ the best materials, and thoroughly cleanse the yarn. He could not even afford to cleanse the yarn to greater loss than 5 per cent. instead of 20 or 25 per cent., as is the practice in Holland and Bridport: and even this small loss of 5 per cent. was more than amply made up by the copious use of wheaten flour paste or dressing, employed to glue or stick together in a flat or horizontal direction the double threads of the chain or warp, of which the navy canvas must be made, according to the regulations of the Navy Boards; being a system of manufacture in direct opposition to that of Dutch canvas, which is wove with single thread and little or no dressing; no more paste at any rate being employed than to protect the threads of the chain in weaving from the friction of the reed, and the mails of the harness. But double-thread canvas cannot be wove without a great deal of dressing, absolutely necessary to glue or stick together the two threads in a flat direction.

The double threads of the chain thus arranged may be likened to a flat tape, and which improperly fills up the reed, giving but a superficial and thin covering to the wooft of the canvas; as it is the chain or warp, and not the shoot or wooft, which comes to the surface, suffers the friction from wear, and supports the whole weight of the sail, whether dry or wet, when bent to the yards. The chain therefore should be strong, spun of the best materials, thoroughly well cleansed, and with two and a half or three more score in the reed, than is required by the Navy Board's regulations. No. 1, is directed to be wove with a $16\frac{1}{2}$ score reed, where-

as there should be at least eighteen and a half or nineteen score. This will fill the chain fully up, and produce a strong close canvas. If the yarn is thoroughly well boiled with alkaline salts, grassed, and bleached, the canvas will never mildew, and will stand its number to the last, will continue close, and will hold or contain the wind, full as well as when the sail was first bent. The present price paid for navy canvas is by much too low, it is only 20*d.* per yard; while the price paid for canvas for the revenue cruisers is from 24*d.* to 28*d.* or 30*d.* according to its width, degree of cleansing, and other circumstances. Former Navy Boards have proceeded on a supposed system of economy, but it has proved, for these thirty years past, a most ruinous one for the British navy. Many a ship and life have been lost, and many an enemy's ship has escaped, from the bad quality and inferior strength of British navy canvas. If the Lords of the Admiralty will cause the proper inquiries to be made at the Board of Customs and Excise, it will appear, that from the superior last of Bridport and Crewkerne canvas, the revenue cruisers are, in proportion to their tonnage, supplied with sails at a much cheaper rate than the navy, besides being exempt from the accidents already mentioned. There is another circumstance in which navy canvas is deficient, namely, that the rope twine, with which the Navy Board is supplied, is at too low a price, and is therefore made of damaged or inferior materials. It is so very bad, that the sails sent on board the King's ships, have frequently to be sewed afresh to the bolt rope, and this always must be done after the sail has been worn some little time, and the dressings and starch washed out. If this is not done, the sail will bag, and cannot be properly braced up on a wind; whereas Dutch and Bridport canvas will stand true, like a board, to the last. Sails are to ships, what wings are to birds—damage or cut their wings, they can no longer fly.

Why is the whole attention of the Naval Board, and the Naval Officers at the different yards, directed to the state and repairs of the hull? A hull is a log on the water, without sails to direct her course; and if these sails are of a bad quality, and sewed to the bolt ropes with bad rope twine, they will give way on a strong press of sail, either in chace of, or when flying from an enemy of

superior force; and the ship fitted out with them will never be able to claw off a dangerous lee shore.

The present system of manufacturing canvas for the navy, is in every part of the manufacture in direct opposition to the Dutch method; as if the difference of latitude and longitude between Helvoitsluice and Harwich, only 120 miles distant, require methods of manufacture diametrically opposite. Dutch canvas has always been admitted to be the best and most durable canvas manufactured in Europe, while the British navy canvas has been experienced to be the worst. Why, therefore, did not former Navy Boards adopt the Dutch method? The late and former commissioners will find it difficult to account for their conduct: they disregarded every representation on the subject made to them by the writer of this, as well as by some of the best informed and most respectable manufacturers of canvas in England; copies of whose letters are to be found at the Navy Board, if not committed to the flames. But Lord Dundonald has copies of many of those letters, which he can produce; and several letters on the subject are in the possession of the Board of Naval Revision, and which, in the strongest manner, corroborate his opinion as to the most judicious manner of manufacturing sail-cloth.

Lord D. is not a theoretical, but is a practical canvas weaver: he had, about five years ago, looms at work; the canvas not for sale or profit, as he never sold any; done to make himself fully acquainted with the weaving branch, as well as the best methods of cleansing the yarn. These experiments of his, cost upwards of five hundred pounds in looms, utensils, rent, materials, and workmen's wages.

Lord D. undertakes to prove every thing stated in this, and in the accompanying papers, to the satisfaction of the present Lords of the Admiralty. He requests to be permitted, and to have an order to go to Deptford Yard, to cut two yards of canvas from twenty or thirty bolts taken promiscuously, and without selection; he engages to prove, that it will lose by two boilings with alkaline salts, from seventeen to twenty per cent. of its original weight. Every sample to be marked, or ticketed with lead, in a manner that shall correspond to the number of the canvas,

and the maker's name. Lord Dundonald requests that his permission to take samples may extend to the hammock stuff, which is at present in every respect deficient and inferior to the hammock stuff when Lord D. was in the navy. In his present and former exertions to improve the manufacture of sail-cloth, he has not, nor has he ever had, the most distant idea of emolument to himself; he loves his country, and is, from many considerations, strongly interested in the success and welfare of a profession to which he once had the honour to belong; having in the year 1770, been Admiral (then Captain) Paisley's lieutenant in the Weazle sloop of war, on the coast of Guinea station.

The present situation of Britain, as respects the countries from whence she was formerly supplied with naval stores, particularly hemp and flax, requires that those articles should be husbanded with the greatest prudence and economy; and should be made in a sound state, to last as long as possible. Lord Dundonald is informed, that the navy has, at present, three years stock of those articles in store. If even but one year can be added to the last of those articles, it is a great object, and will give full time for bringing forward the necessary supplies from Canada, the East Indies, &c. or for the cultivation of hemp and flax in the fens, and reclaimed bogs of Great-Britain and Ireland, for which they are well adapted. This will not take any part of the land from tillage or pasture: a bounty should be given on the sound and dressed hemp thus raised; likewise a premium for saving the seed of hemp which had been sown for the express purpose, but no premium on the hemp itself, as, from the ripening of the seed, it is of an inferior quality, and only fit for coarser purposes. Britain will likewise suffer as to the supply of iron she formerly got from Russia and Sweden; but that will be but for a time: the manufacture of coak-made iron is rapidly advancing in Britain, and should be encouraged by the legislature instead of being saddled with a duty, as was proposed to be done by the two late Chancellors of the Exchequer.

The war with Russia will promote in Britain the manufacture of the coarser fabrics of linen and hempen cloth, formerly had from Russia and Silesia. The cotton manufacture may, for a

time, decline, but the linen manufacture will proportionably advance. Without British capital, Russia may shut up shop. Her hemp, flax, iron, tallow, pot and pearl ashes, and linens, will remain on hand; manufactures and trade will be at a complete stand; and Alexander may, ere long, meet with the fate of his father and grandfather.

Methods of Manufacturing Dutch and British Navy Canvas.

DUTCH CANVAS.

Chain or Warp, single, of Italian hemp.
Shoot or Wooft, of the tow of ditto, ditto.
The yarn cleansed to a loss of 20 per cent.
Little or no dressing employed.
Chain contains at least three-score more yarns than British navy canvas.
The shoot well driven up; canvas close, and, as it were felted.
Stands its shape, number, and weight to the last, when made into a sail.
Does not mildew.

BRITISH NAVY CANVAS.

Chain or Warp, double, of flax.
Shoot or Wooft, of the longs of hemp.
Yarn cleansed to a loss of from 3 to 7 per cent.
A very great proportion of wheaten flour dressing employed, to glue or stick together the double threads.
Chain not near so close and strong as Dutch canvas.
The shoot being of the longs cannot be driven so close up.
Does not stand its shape, number, and weight; when made into a sail, loses from a fifth to a sixth of its weight.
Is liable to mildew.

Report on Dutch, Danish, and Bridport Sail-Cloth.

HOLLAND DUCK, OR DUTCH CANVAS.

Breadth, 30 inches.
Chain single, of Italian hemp.

Thirty single threads in the inch of chain.
The shoots, of the shorts, or tow of ditto.
The shoot well driven up, and canvas close.
Wove with little or no dressing.
Cleansed in the yarn, to a loss of 20 per cent.
Will not mildew.

DANISH CANVAS, HEAVY NUMBER.

Breadth, 31 inches.
Chain double, of hemp.
Eighteen double threads in the inch of chain.
The shoot, of the longs of flax.
Canvas well manufactured.
Wove with less dressing than the British navy canvas.
The canvas apparently callendered.
Cleansed to a loss of 17 per cent.
Will not mildew.
Is in every respect preferable to British navy canvas.

LIGHT NUMBERS OF DANISH CANVAS.

Breadth, 29 inches.
The one apparently a No. 4 or 5, the other a No. 8.
Both chain and shoot of flax.
The yarn well spun, and canvas well wove.
The yarn not cleansed at all.
Loss on boiling No. 5 with alkaline salts, 20 per cent.
Ditto ditto No. 8 ditto 17 per cent.
Liable to mildew.

Samples of Canvas of the Manufacture of Bridport, made by Messrs. FOWLER & SON, *viz. Nos.* 1, 2, 3, *and* 4.

Breadth, 24 inches, corresponding to the width of navy canvas.
The chain single, of the longs of flax.
The shoot, of the tow of flax.
Well wove, and close driven up.
Thoroughly boiled and bleached, to a loss of 25 per cent.
Will not mildew.

Is used by all the revenue cruisers, packet boats, and smacks of Great-Britain.

One suit of Bridport sails will outlast two suits of British navy-canvas, as at present manufactured.

	PER YARD.
Price of Bridport Canvas, No. 1,	23½*d.*
Price of navy canvas, do.	20*d.*
2 yards of navy canvas, at 20*d.*	40*d.*
1 yard of Bridport, at 23½*d.*	23½*d.*
Saving equal to 42 per cent.	17½*d.*

The Bridport canvas may be further improved, by putting more yarn in the chain, like Dutch canvas, in which case the manufacturer should be allowed 1½*d.* more per yard.

2 yards of navy canvas, at 20*d.*	40*d.*
1 yard of Bridport, improved, at 25*d.*	25*d.*
Saving equal to 37 per cent.	15*d.*

But say that two suits Bridport canvas did no more than outlast three suits of navy canvass. The expense will be as follow:

3 yards of navy, at 20*d.*	60*d.*
2 yards Bridport improved, at 25*d.*	50*d.*
Saving nearly 17 per cent.	10*d.*

But say even that three suits of Caker did no more than outlast four suits of navy canvas:

4 yards navy canvas, at 20*d.*	80*d.*
3 yards Bridport ditto, at 25*d.*	75*d.*
Saving upwards of 6 per cent.	5*d.*

Besides the many advantages already stated in this paper, in consequence of the navy's being supplied with the best possible canvas.

Lastly, Lord Dundonald most earnestly recommends this paper to the perusal and consideration of the Lords of the Admiralty. The manufacturers of Bridport and Crewkerne are fully

able to supply the navy with canvas, if a proper price is allowed them for it. But they should have notice given them in time, that they may prepare the yarn early in the spring, and which should be of hemp and not of flax, at least the chain should be of hemp: the shoot may be of flax tow, as it is softer and drives up better than hemp tow, that is, unless great pains are taken to soften it by beating.

HISTORICAL Sketch of the Origin, Progress, and present State of Trade and Commerce in general, with the Produce and Manufacture of each Country in the four Quarters of the Globe.

COMMERCE may be defined to be the exchange of the natural or artificial productions of a country for those of another, either by barter, or by representative signs of their value; and as coin or bullion is the most general representative of the value of other commodities, the profits of commerce are hence frequently, but erroneously, estimated by the quantity of money it brings into a country. But a very beneficial trade may be carried on without any balance being payable in money: or that balance may (as is the case with Britain) be absorbed by payments on other accounts: for notwithstanding our commerce has long been in a very flourishing state, and has been extended to a degree unparalleled in history, yet the quantity of specie and of bullion in the country has not been materially augmented.

The most early mode of carrying on trade was obviously by barter: for it must strike every reflecting individual; that commerce is nearly co-eval with the creation; and a very small increase of mankind was sufficient to prove its utility, and to demonstrate the natural dependance our species had upon one another. By the wise dispensation of Providence, their simple occupations were suited to their wants; and the diligent discharge of the one rendered sufficient to supply the moderate demands of the other; and though agriculture, or the feeding of

flocks, were the sole labours of the first inhabitants, yet (limited as they were) they could not be exercised with that comfort their great Creator designed them, without mutual correspondence and traffic; and hence (notwithstanding the plausible and confessedly ingenious but erroneous arguments which have recently been adduced, to evince the possibility of a state existing "*independent of commerce*,") an exchange of commodities necessarily took place. Such was the origin of commerce in the infant world, and in this state it continued so long as our progenitors could content themselves with the riches of nature, and were not obliged by a growing posterity, to alter their method in disposing of them. In consequence, however, of the increase of mankind, and the progress of civilization, commercial intercourse became more extended, and other representative signs were found to be necessary. This led to the discovery of coin or money: and, as buying and selling, through that medium were found most convenient in their commercial transactions, this method was invented and adopted in lieu of barter by the most polished nations, and by whom it has been transmitted to us, with the exception of those savages, where the use of coin has hitherto remained unknown, and their traffic is carried on in the primitive way, though not always with primitive simplicity. Previously, however, to this change, and before the great increase of population, their desires were easily satisfied, being limited by their wants: they contentedly made the fleece of their sheep serve them for clothing, and their hunger found a ready supply from their gardens and kine: a neighbouring spring slacked their thirst: and a tree, or a tent, was sufficient to defend them from the inclemencies of the weather, in those climes where the first race was settled.—Their labour procured them a satisfactory support, and the products of the earth and of their cattle served them both for necessaries and regales, till corruption brought in fraud: this gave birth to avarice and violence; the stronger began to invade the weaker; and, as these oppressive acquisitions could only be maintained by force and policy, cities were built, and governments formed. Afterwards, when by this means an aggregated number swelled to too great a magnitude, to have their necessities supplied by their neighbouring

territories, they were compelled to seek for remoter helps through the medium of commerce. Although it cannot be concealed that the introduction of commerce led the way to luxury and excess; which, progressively increasing with the extension of trade, ultimately undermined that simplicity of manners, and utterly subverted the primeval state of society; yet, the increase of mankind, and the consequent peopling of different parts and continents, rendered the continuation of commerce absolutely necessary for their comfort and support. Without this means of mutual assistance, life itself would have proved burthensome.

At length the views and designs, the desires and wants of men, expanding in proportion to the increase of population, trade was no longer confined to the providing of mere necessaries, but profit was sought in, and became a motive to, the carrying it on. This motive, however, might occasionally have promoted both unity and good will among men, had the correspondence been conducted with that sincerity it ought; and by this means rendered productive of those reciprocal benefits and advantages, which naturally accrue from the supplying the wants of one country, with the superfluities of another. And, notwithstanding the accomplishment of this desirable object has been frustrated, by the degeneracy of mankind rendering ambition and avarice the motives to the continuance and extension of trade, more than want; yet these sinister designs have ultimately proved very beneficial to these latter ages. For, without such excitements, it is probable that the greatest part of the world would still have remained unknown to us. But instigated by the desire of gain, in order to support the one, and satisfy the other, men have made those numerous discoveries which lay hid for ages; alike regardless of inconveniencies and of dangers, the pleasing prospect of attaining riches and preferments animated them to fresh engagements, and a succession of these, opened to us the wide field of trade that now lies before us. Whatever the motives were to the daring enterprizes of former ages, it must be confessed that we of this age are greatly indebted to the undertakers of them, for many of the comforts and conveniences of life. And as the design of this sketch is to show the advantages we receive from their labours,

and to deduce the growth and progress of trade, from its earliest beginnings, the preceding considerations, it is apprehended, will not be regarded, either as useless or irrelevant. In the subsequent pages it is proposed concisely to exhibit the beneficial influence which trade has ever had, and still has, on human affairs, and that all nations have increased in strength and power, or remain weak and abject, in proportion as they have encouraged or neglected commerce.

Whoever views the history of former ages, in the most cursory manner, will find, that the histories, even of the most warlike nations, will furnish him with as large accounts of their commerce as of their conquests; and that the narrative is equally extensive and full on the one subject as on the other.

If the greatest empires were established by valour and the force of arms, they were strengthened and supported, only, by the success, with which trade (in conjunction with the labour and industry of the people) furnished them, and the conquerors would soon have languished and perished with the conquered, had they not resorted to the riches which agriculture, manufactures, and commerce produce, in order to preserve and improve, by the tranquil arts of peace, the advantages acquired in the horrors and tumults of war.

It is by no means certain who were the first navigators in the world: the honour being claimed both for the Phenicians, and also for the Arabians. Nor, at this distance of time can this question be ascertained with any degree of precision. One fact at least is certain, that both those nations carried on commerce to a very considerable extent; while the rest of the world was utterly ignorant of the advantages resulting from foreign trade and commerce.

ON THE COMMERCE OF THE TYRIANS.

On examining the commerce of the ancients, the Phenicians, and Tyre their capital, are the first that present themselves; and these will sufficiently prove to what a height of glory, grandeur, and riches, a nation is capable of attaining by the sole resources of commerce.

The Phenicians, it is remarked by M. Huet,* occupied only a narrow tract of land along the sea-coast; and Tyre itself was erected on an ungrateful barren soil, which, even in the most fruitful and productive seasons, was insufficient to support the great number of inhabitants, whom the first success of trade had attracted thither.

Two advantages, however, indemnified this defect; they had excellent ports on the coast of their little state, particularly of their capital; and they were born with so happy a genius for trade, as generally to be associated with the Egyptians, in the honour done these latter, by supposing them the inventors of naval commerce, particularly that of long voyages.

The Phenicians knew so happily how to profit by these two advantages, that they soon became sole masters of the seas and of commerce. Lebanon, and the other neighbouring mountains, furnished them with excellent wood for the construction of their ships; and they had in a short time numerous fleets, which ran the hazards of unknown voyages to establish their trade; and as their people multiplied almost to infinity, by the great number of strangers, whom the desire of gain, and the certain prospect of anquiring wealth, drew to their city, they found themselves in a condition to send out many colonies, particularly that famous one of Carthage, which preserved the Phenician spirit with respect to traffic, and was in no respect inferior to Tyre in point of trade, while it greatly surpassed the latter in the extent of his dominion.

The degree of glory and power to which Tyre had been raised, by commerce and navigation, rendered her so famous, that the report of prophane authors would hardly be believed destitute of exaggeration, had not the prophets themselves spoken of her with still greater magnificence; so that the description of her grandeur, of her forces, and the almost incredible number of her vessels, merchants, and merchandises, renders it impossible to pass unnoticed one of the most beautiful passages in the prophecy of Ezekiel, when we are speaking of the excellence of

* Bishop of Avranches or Soissons, in his ingenious but desultory "Treatise on the Commerce of the Ancients."

commerce, and the splendour it diffuses. Isaiah says, that Tyre is the common city of all nations, and the center of all commerce, and, in a word, is the queen of cities, of which the merchants are princes, and which has for traders the most illustrious persons of the earth. Such was the ancient Tyre when she fell under the arms of Nebuchadnezzar, after a siege of thirteen years. An asylum and resource, however, had providentially been secured by the inhabitants of this unfortunate city; for the Tyrians, during so long a siege, had both the precaution and time, to fortify a neighbouring island, where they established their maritime forces, and whither their merchants retired with their stores and merchandises, and continued a business so flourishing, that the taking and ruining of their first city, did not destroy either their empire of the sea or the reputation of their commerce.

It was this new city of Tyre, which, trusting in her riches and puissance, dared in after times to resist Alexander the Great, already master of one part of Asia, and threatened to interrupt, for some time, the course of his victories. Her temerity drew down upon her the utmost vengeance of the conqueror, by whom Tyre was entirely destroyed: and in order that no hopes might remain of being raised from her fall, he removed her marine and commerce to Alexandria, a new city, which he intended to make the capital of the empire of Asia, of which he then meditated the conquest.

COMMERCE OF THE CARTHAGINIANS.

In the mean time, the Tyrian colony of Carthage augmented its forces by trade, and thus put itself in a condition at once to dispute with Rome the empire of the world.

These new Africans soon repeated the benefits which the happy situations of their city offered, and profited by their native genius for trade and navigation. They made their fleets and merchants pass on one side to the ocean, beyond the pillars of Hercules, through the Straits of Gibraltar; and on the other, along the whole western coast of Europe; and if some accounts may be credited, their pilots and their merchants even had the

boldness, or good fortune, to be the first that penetrated to unknown lands, of which the discovery, many ages afterwards, has done so much honour, and brought so much profit to the Spaniards.

Totally immersed in their commerce, the Carthaginians never thought (till too late) of valuing themselves on the immense riches which they had thus amassed for extending their dominion abroad; but their desire of throwing off their pacific merchant state, cost them dear. Their city, which trade had peopled with above seven hundred thousand inhabitants, was soon deserted, to furnish their armies with troops and recruits. Their fleets, accustomed solely to carry their merchants and merchandise, were now laden only with soldiers and warlike stores; and of their wisest and more fortunate traders were formed those chiefs and generals of armies, who were destined to make Rome tremble, and put Carthage in a condition to become the mistress of the world.

The great military achievements of the Carthaginians in Sicily, Sardinia, Spain, and particularly in Italy, under the famous Hannibal, and also the disorder of their affairs by the victories of the two Scipios, are facts well known, and are of too little import to the matter now in discussion to require any detail of them. It may suffice, therefore, to add, that to so high a degree of riches and power had Carthage been raised by trade, that the Romans were engaged in a cruel and doubtful war of 50 years to subdue this rival; and in fine, triumphant Rome believed she could not entirely subjugate and reduce her by any better means than by cutting off those resources which she might yet find in trade, and which, during so long a time, had supported her against all the forces of the republic.

It was, in effect, that resolution of the senate, which decided the fate of Carthage; and the Carthaginians themselves were so terrified, that having apprehended by this design, they should be obliged to give up their fleet, and to retire inland five leagues from the sea, they chose rather to expose themselves to the hazards of the third punic war, so fatal to them, than to renounce, so easily, the only hope that could remain to them in their misfor-

tunes, and voluntary consent to see their commerce pass to Utica, whither they knew the Romans, to achieve their ruin, proposed to transfer it, as Alexander did that of Tyre, to the new city, to which he had given his name, when he determined to punish the Tyrians for having dared to retard his conquests.

COMMERCE OF THE ARABIANS.

Although it is a question involved in considerable uncertainty, whether the Arabians were the first inventors of navigation, and consequently of commerce; yet, from the peculiarly favourable situation of their country, it is highly probable they were among the first people who turned their attention to nautical pursuits. The extensive peninsula of Arabia is washed by the sea on three sides: and access to it on the fourth being rendered very difficult on account of the dangerous sandy deserts which bounded it, necessity seems to have compelled them to open communications by water with distant countries.

From the articles with which we know the Arabians supplied the Roman world, it is evident that they must have traded with India, and the principal islands (which the periodical winds denominated monsoons might enable them to do without the aid of a compass, as some do even to this day:) for gold, precious stones, rich stuffs, silks, &c. were the produce of ancient India, Arabia yielding only frankincense, balsam, myrrh, and the well known calamus aromaticus.

As the limits of this paper forbid the extension of the present article, we reluctantly refer the reader, who is desirous of further information on this subject, to Dr. Vincent's elaborate work "On the Commerce and Navigation of the Ancients," 2 vols. 4to, 1807.

COMMERCE OF THE EGYPTIANS.

Alexander lived too short a time to witness the happy and flourishing state to which commerce would elevate this last city. The Ptolomies, who after his death had Egypt for their part of

his conquests, took care to support the infant trade of Alexandria, and soon brought it to such a degree of perfection and extent, as to bury in oblivion both Tyre and Carthage, which, during so long a time, had carried it on, almost alone, and had re-assembled to them the commerce of all other nations.

This sudden success of the commerce of Alexandria, will cease to excite surprise, when we consider the felicity of its situation, which rendered it so commodious an emporium for all the merchandises both of the east and of the west.

On one side this famous city had a free commerce with Asia, and all the east, through the Red Sea: the same sea and the Nile, gave her entrance into the vast and rich countries of Ethiopia. The commerce of the rest of Africa and Europe, was open to her by the Mediterranean; and, if she was disposed to carry on the interior commerce of Egypt, she had, in addition to the conveniency of the Nile, and the stupendous navigable canals made by the first Egyptians; she had, I say, the help of caravans, so convenient for the safety of merchants, and for the transportation of their commodities. Further, there was added a large and safe port, where foreign vessels arrived from all parts, and whence the Egyptian vessels were constantly conveying their merchants and commerce to all parts of the then known world.

It was this conveniency of depositing merchandise at Alexandria, that spread through all Egypt those immense riches, which rendered their kings sufficiently powerful to support themselves, for more than an age, against the Romans, who endeavoured from time to time, to subdue so fine a kingdom: so considerable indeed were these riches, that historians affirm, that the product only of the customs of importation and exportation, upon the merchandises that passed the custom-houses of Alexandria, amounted annually to about 2,250,000*l.* sterling, (a vast sum in those days,) notwithstanding the major part of the Ptolomies levied but moderate imposts on their people.

COMMERCE OF THE ROMANS.

Previously to the battle of Actium, the Romans had always found, in the spoils of the nations they had subjected, resources from which they could fill the treasury of the Republic, and at the same time furnished a sufficiency for the expenses, in which the plan of a universal monarchy continually engaged them. But when the resources began to fail them, the commerce of Egypt seemed well calculated to support by its riches, (and we may add by its credit) the reputation and empire of Rome.

From the time Augustus reduced this kingdom to a province, he earnestly endeavoured to make the trade of Alexandria more flourishing than ever; and at the same time he augmented that commerce, which the Egyptians had always maintained, or carried on in Arabia, the Indies, and to the most remote parts of the east, through the Channel offered by the Red Sea.

Under such auspices Alexandria became inferior only to Rome itself, in grandeur and in population. The magazines of the capital of the world, were no longer filled but with the merchandises which came to it from the capital of Egypt; and in a very short time not only Rome, but all Italy were indebted for their subsistence to the vast quantity of corn and other provisions, brought by the merchants and Egyptian fleets. So great were this quantity and abundance, that the historian, Josephus, affirms, that Alexandria yielded more riches to the Roman treasury in one month, than all Egypt in a year: although, if Pliny's calculation is to be credited, the profits of the Egyptian commerce amounted yearly for Rome, to 125,000,000 crowns, (upwards of 28,000,000*l.* sterling), that is to say, a hundred times more than the Romans employed, whose ordinary expenses did not amount to above 1,250,000 crowns.

This great trade, (which soon caused that of all the other provinces of the empire to flourish) augmented incessantly, and made the senate determine to maintain it by the corporations it established in Rome, for trade and traders, by the laws which it made in their favour, (or rather by those of the Rhodians, which

it adopted, and which are long since become a species of the law of nations, for the navigation and commerce of the Mediterranean) by the magistracy whom it charged with their execution, and by the protection which it afforded to the merchants, as well strangers as Romans, in all the extent of the empire.

At length, Alexandria met with the fortune of Tyre and of Carthage. She had been raised by trade, and the fall of her trade overset her. The Saracens, who seized on Egypt, in the reign of Heraclius, having, by their cruelties, driven away the merchants, this city, which then held the first rank after Rome and Constantinople, hardly preserved any thing of her ancient splendour; and though she afterwards regained some vigour under the Sultans, and has continued to flourish, in some degree, from the Christian nations, which carry on the Levant trade, and maintain a tolerable good business; it is, however, no longer possible to recognise that ancient Alexandria, so famous for her trade, and which was for so long a time the glory and support of an empire, founded indeed, by arms, but which received its principal strength from commerce.

COMMERCE OF GAUL.

Before we notice the commerce of the moderns, it may be proper to annex a few particulars respecting those cities of ancient Gaul, which were formerly rendered famous by the enterprises of their merchants.

Massilia, or Marseilles, the most ancient ally of the Romans, was equally celebrated for its antiquity, for the wisdom and equity of its senate, for the sciences taught in its academies, for the many colonies it established, and for the wars it gloriously maintained against so many different people, jealous of its riches; but for these advantages it was indebted only to its trade: and it was solely by means of commerce, that it arrived in so short a time, to that high point of respect and power, as to render it for a long time the arbitrator of the neighbouring nations, who were attracted thither to learn the arts and politeness of Greece,

which its first inhabitants brought from Asia, when they left it, to settle among the Gauls.

The example of Marseilles soon animated the greatest part of the Gallic or French cities to trade, more especially such as were situated upon the same sea, or that were not far distant. Arles became famous for its experience in navigation, and for its ability in the art of building ships. It likewise distinguished itself for the invention of curious manufactures, and above all for its works in gold and silver, which gave it a great reputation. Narbonne even yet exceeded Arles, and so long as its port existed, it saw fleets arrive there from the East, Africa, Spain, and Sicily, laden with every kind of merchandise; while the inhabitants on their side, equipped their own ships to carry abroad the products of their country, or the manufactures which their own industry had raised.

When the alteration of the course of the River Aude, had occasioned its deserting the port of Narbonne, Montpellier arose upon the decline of the former: and the latter city now received in her own harbour ships from all parts of the Mediterranean.

Besides the cities here mentioned, there were several others which flourished in a considerable degree, from the influx of wealth occasioned by commerce, although they were considerably inferior. Among these, may be noticed Toulon, Frejus, &c. and particularly Aigue-Morte, before the sands of the Rhone had left it at a distance from the sea. From this last port it was, that the embarkations were made in the reign of St. Lewis for those romantic expeditions, the Crusades; which, by draining the different countries of their most turbulent subjects, and by promoting a more extensively mutual intercourse, did unquestionably tend to promote civilization of manners, as well as to improve commercial and nautical science.

In the interior of ancient Gaul, the principal emporium was Lyons; which being situated at the confluence of the Rhone and Saone, became a general staple or warehouse for all the various articles of the then French trade; exclusive of the commerce which she carried on with Egypt and the Levant by means of her correspondence with Arles and Marseilles.

At this period the ancient history of commerce properly terminates. We shall review its progress, during the middle ages, and thenceforward trace its course down to the present time.

THE HANSEATIC LEAGUE.

The fall of the Roman Empire involved in its destruction the ruin of all the people who had submitted to its sway. The inundation of the Barbarians, which proved so fatal to the sciences and polite arts, operated with equal detriment to trade: and, as the learned beheld their libraries and the finest monuments of art and of literature remedilessly sacrified to the flames, by a people, equally ignorant and fierce, so neither had the merchants more ability to rescue from their fury their numerous fleets, (which covered the seas,) or their vast magazines and warehouses, which were constantly full of the most useful as well as valuable articles of commerce. Hence it necessarily followed, that while these sanguinary hordes were contending with the Roman arms, or were disputing among themselves for the possession of the countries they had usurped, all their commerce consisted only in the spoils of the vanquished: nor had they any other trade but the dividing of the immense treasures which they had found amassed in all the towns of the empire they had sacked, and especially in Rome, the metropolis of the then known world; which repeatedly became a prey to their fury and to their avarice.

But the intercourse, which insensibly was promoted between the victors and the vanquished, contributed by imperceptible gradations to soften the ferocious manners of the former; and after the establishment of the powerful monarchies that arose on the ruins of the Roman empire, the conquerors soon learned from the people, whom they had subjugated and with whom they associated, the necessity of commerce, and the means of carrying it on with success. Some of the most sanguinary of these Barbarians, shortly afterwards, became so expert in trade, that they were enabled to impart its principle to others: and to the Lombards are we indebted for the invention and usage of

the Banking System, Exchanges, the principles of Book-Keeping with double entries, and various other practices, which facilitate and secure commercial intercourse.

From the imperfect information which the scanty annals of the middle ages will afford, it appears that trade began to recover from the shock occasioned by the subversion of the Roman empire, first in the southern parts of Europe, and very shortly afterwards (if not contemporaneously) in the northern coasts of that quarter of the globe. A Society of Merchants was there formed, which not only brought commerce to all the perfection it was capable of acquiring, previously to the discovery of America and the East and West Indies; but which also began to give it those laws which have continued in force under the name of *Uses* and *Maritime Customs*, and to form a kind of code, the first, indeed, of those which have been made for the regulation of trade.

This society was the celebrated association of the Hanse-towns, better known in history under the name of

THE HANSEATIC LEAGUE.

These towns were originally a confederacy, united in alliance for the mutual support and encouragement of their commerce; at no period, does the history of the world present a more extraordinary example of the effects which industry and a strict union of interests can produce, than this singular confederacy; which was first set on foot by the city of Bremen and several sea-port towns in Livonia, about the year 1169, although some historians* post-date it to 1200, and 1241. In the first mentioned year, the destruction of the two commercial cities of Julian and Winnet by the Danes, and other pirates of the north, dispersed their merchants into the cities of Lubeck, Rostock, &c. which had recently been erected on and near the Baltic Sea,

*De Thou, and Lambecius. See Anderson's History of Commerce, under the year 1169. Oddy's European Commerce, 4to. 1805. Mr. Butler's Revolutions of the Germanic Empire, 8vo. 1807, Mallet, de la Ligue Hanseatique, 8vo. 1805.

and thus occasioned the Mercantile Association, whose principles and trade, the subsequent pages are to disclose. These cities were anxious to protect themselves against a similar calamity: the first that entered into this association were Lubeck, Wismar, Rostock, Straelsund or Stralsund, Grypeswald, Anclam, Stettin, Colberg, Stolpe, Dantzic, Elbing, and Konigsberg. The advantages which they derived from the confederacy attracted other trading towns to it: and at one time eighty towns or cities were enumerated among the association. They were divided into four classes:

I. The Vandallic, which comprised the towns on the Baltic between Hamburgh and Pomerania. Over this division presided Lubeck; whose power and opulence rendered her the head of the union: to this city were committed the common stock and records of the confederacy, and here the general assemblies of the association were held.

II. The Rhenaan, over which Cologne presided, included the towns situated on the Banks of the Rhine in the then territories of Cleves, Overyssel, Guelderland, Mark, and Westphalia.

III. The Saxon, contained the towns in Saxony, of which Brunswick was the head.

IV. The Prussian comprehended the towns of Prussia and Livonia, which were under the direction of Dantzic.

There was, however, another general division of the Union towns into Easterlings, (which included the towns on the coast of the Baltic), and Westerlings; which (as the name imports) comprised those situated towards the Rhine, of which Cologne was the principal, as Lubeck was the head of the eastern Hanse-towns. Of many of the places, which entered into this confederacy, not a single vestige now remains: and as such of the towns, as still retain any degree of their commercial prosperity, will be noticed in future numbers, under the respective countries with which we at present have, or lately had, any commercial intercourse, a few particulars respecting the regulations and principles of the *Hanseatic League* shall now be presented to our Readers.

It was a standing rule of the Hanseatic Confederacy, that no city should be admitted into it, which was not situated either on the sea, or on some neighbouring river that was commodious for maritime commerce, and which did not keep the keys of its own gates. Another permanent regulation was, that each member of the association should have the civil jurisdiction in its own hands, although in other respects such city was allowed to acknowledge a superior lord.

At a period like this (the thirteenth century), when war and military exploits constituted the principal glory and employment of sovereigns, princes, and feudal chieftains, the policy of these trading republics was necessarily productive of benefit; and the prudence, with which their commercial concerns were conducted, was equally conspicuous in their choice of the person whom they selected for their protector. As it was expedient to choose one who was a member of the German empire, they elected the Grand Master and German Knights of the Cross, (better known in after ages by the appellation of the Teutonic Order), who were established in Prussia, and had recently conquered the province of Livonia. By this means the Hanse-towns became possessed of all the commerce of the Baltic, from Denmark to the bottom of the Gulph of Finland, together with the trade of the rivers, which discharge themselves into that sea from the interior of a fine country, yielding a great variety of articles that were of considerable value and important in the commerce of the world. The Hanseatic Confederacy* convened an extraordinary general assembly every ten years, at which the Union was solemnly renewed; new members were admitted; and old member were excluded, if proper reasons were assigned. This league was solemnly renewed in the year 1284, and was afterwards repeatedly confirmed in succeeding ages.

In proportion as the reputation, opulence and forces of the confederacy increased, there were few trading towns of note in Europe that were not associated with it; rather, it should seem, as

* Oddy's European Commerce, p. 12. Anderson's History of Commerce, vol. 1. p. 87, folio edi.

factories and warehouses, than as members of the corporation personally represented at the general assemblies.

Thus, France furnished to the confederation, Rouen, St. Maloe, Bourdeaux, Bayonne, and Marseilles—Spain, Cadiz, Barcelona, and Seville—Portugal, Lisbon—Italy and Sicily, Messina, Leghorn and Naples—Russia, Novogorod—Norway, Bergen—The Low Countries or Netherlands, Antwerp, Dort, Amsterdam, Rotterdam, Ostend, Dunkirk, and especially Bruges, which was one of the wealthiest cities in Europe, and in 1310 contained not less than sixty-eight companies of traders and artificers; while its citizens rivalled many of the European monarchs in their sumptuous mode of living. Some idea of their splendor may be formed, from the following anecdote recorded by Dr. Robinson;* who relates that, in the year 1301, Joanna of Navarre, the wife of Philip the fair, King of France, having been some days in Bruges, was so much struck with its grandeur and wealth, and particularly with the splendid appearance of the citizens' wives, that she was moved by female envy to exclaim with indignation, "I thought that I had been the only queen here, but I find that there are many hundreds more."

In consequence of a dispute with the emperor Maximilian, Bruges was deprived of a considerable part of its trade, and fronr that time the city of Antwerp took the lead in commerce; but taxes and imprudent regulations insensibly undermined the general trade of the Netherlands, and carried part of it to England, and the remainder into Holland. Few persons have seen, without surprise, the long and splendid line of towns between Ostend and Liege. When we consider, that they have survived their commerce for more than two hundred years, we may form some notion of the general populousness and magnificence of the territory and its inhabitants in the day of their prosperity.

Lastly *England* furnished London to this celebrated Association whose warehouses and factory were at the very spacious building then called and now in existence by the name of the

* Historical Disquisition concerning India, p. 239.

Steel-Yard. Here they carried on a most extensive and lucrative trade* in every article of necessaries and of luxury then known; being favoured by numerous privileges which had been conceded at various times by different English Sovereigns, and which they retained till the time of Edward VI. when the British Merchants most severely felt the inconvenience of such exclusive privileges. The Merchants supported their own claims, by accusing the Hanseatics of monopoly, of defrauding the customs, of extending the privileges granted to them far beyond the original intention, which only went to give to certain towns privileges relative to articles of their own produce; whereas they had become general merchants, and had extended the same advantages to places never intended. England, which had long been rising in the woollen manufacture, as a rival to Flanders, possessed none of the advantages of foreign trade; for, of the cloths manufactured, not one-twentieth were exported by English merchants, but the whole nearly by those of the Hanseatic towns.

When, with the advice of the Privy Council, Edward VI. deprived the Hanseatics of their privileges, the case was instantly reversed, and the export trade fell nearly all into the hands of English merchants.

The privileges of the Hanseatic body, at the Steel-yard, were again restored by Queen Mary, who was married to Philip, the son of the Emperor; but this was of short duration, and a conclusion to their successful convention with England was put in the following reign of Elizabeth; when the Hanse Towns, in conjunction with the Emperor of Germany, mistaking their own power, and the vigour and wisdom of the English Queen, banished all the English merchant-adventurers, with a view to compel her to renew the privileges in England that had first been revo-

* The articles imported by the Easterlings into England were corn, cordage, linen, cloth, hemp, flax, pitch, tar, masts, pipe staves, steel, iron, wax, wainscot; but, as corn, of which they imported great quantities, sometimes arrived when the prices were very low, the proprietors of land and farmers complained, and an act was in consequence passed, in the reign of Edward IV. (in 1463), by which corn imported was forfeited, when the price of wheat was under 6s. 8d. the quarter, rye, 4s. and barley 3s. This act was not repealed till the time of James I. near two hundred and fifty years after.

ked during the short reign of her brother Edward, and renewed by Mary, but again suspended.

The effect produced was directly opposite from that intended, and, instead of renewing the privileges, that spirited Queen ordered the Steel-yard-house to be shut up on the same day that the English merchants were ordered to quit Germany; thereby putting an entire stop to this commerce, which, by means of their great capital and superior knowledge, was still considerable, though not protected by any peculiar privilege, as they had only traded for some time on the footing of her Majesty's subjects.

This unfortunate retaliation occasioned an assembly of some of the principal members of the League at Lubeck, in 1591, when they remonstrated in a style of indignation, reproach, and menace; to which Queen Elizabeth answered, that she was willing to attribute their want of respect to their secretary, but that she set no sort of value on their hostile intentions.

There is no doubt that the assistance which those towns had attempted to give in fitting out the great Armada* for the invasion of this country, had not a little contributed to this inflexible severity; but it was an effect arising from the progress of things which must very soon have been produced.

Originally, it may be recollected, the only objects of the confederacy were,—to secure their commerce against the pirates and plunderers of Denmark and Norway, who from the ninth to the twelfth century had desolated Europe, and held the absolute dominion of the seas;—and also by peaceable and friendly communications to extend their trade. By their prudent management, in the course of time, we have seen them rise to such a degree of power as to engage in treaties, and to insist in high language on having their own terms granted by the sovereigns with whom they entered into negociations. The most flourishing period of the Hanseatic league was, at the end of the fourteenth, and the beginning of the fifteenth century. It then presumed to declare and to carry on offensive and defensive wars with the sovereigns of Europe, over whose fleets and land-forces they

* Sixty ships laden with stores for Spain, belonging to the Hanse Towns, were taken or destroyed by the English.

frequently obtained signal victories, which for a short time procured the advantages thereby sought to be obtained.

For instance, in 1348,* the League engaged in a naval war with Waldemar III. King of Denmark; which was occasioned by that monarch demanding toll for vessels passing the Sound. The circumstances of the contest are not well known; but that it terminated in favour of the League is clear, from this circumstance, that the king was glad, in order to obtain peace, to grant them the province of Schonen, for thirteen years, by way of indemnity. This is the first account existing of any toll demanded in passing the Sound, which has since been the cause of much vexation to the commercial world. Soon after, another war broke out between those same merchants and the king of Denmark, which ended much more gloriously for the former. In 1395, the Hanseatic League triumphed† over Queen Margaret of Denmark, a woman of great abilities and enterprize, and who had united, under her single authority, Denmark, Sweden, and Norway. They compelled her to deliver up King Albert and his son, who were her prisoners, and also to give them Stockholm. The cities of Lubeck, Hamburg, Dantzick, and five others of the Hanseatic League, bound themselves in the sum of 60,000 marks, that King Albert should, within three years, resign the whole kingdom of Sweden.

But the most celebrated expedition of the Hanse Towns was undertaken in the year 1428; when the *Vandallic Division* (comprising the towns on the coasts of the Baltic,) fitted out a fleet at the port of Wismar, consisting of 260 ships, carrying 12,000 men, exclusive of the sailors, which were designed to destroy Copenhagen a second time, (they had succeeded in taking the city in 1362); but, notwithstanding their numbers and their force, this design was frustrated.

It was, unquestionably, at this time that the Hanseatic League attained the summit of their power: Nor, perhaps do the annals of history at any period of the world present a more striking instance of the great object which may be achieved by a strict

* Anderson, vol. 1. p. 178. † Ibid, vol. 1. p. 220.

union of interests. But from this time, the decline of the union must be dated. Their fall, Mr. Oddy justly remarks, began in their becoming warlike instead of commercial, and preferring political importance to wealth obtained by their original modes. The rise of Holland accelerated their decline; and the general attention which other nations began to pay to manufactures and commerce, by distributing them more equally amongst people, in different parts of Europe, destroyed that superiority which the northern nations had so long enjoyed.

In addition to this circumstance, the discovery of the passage to India, by the Cape of Good Hope, and of America, with the facility which the discovery of the magnetic needle had given to the navigation of the ocean, produced a great change, and it was of an unfavourable nature for these towns. In the first place, the Italian cities, which had till then possessed exclusively the commerce with Asia, lost that lucrative trade, the whole of which fell into the hands of the Portuguese; who nevertheless, still found it necessary to have their depôts, for the north of Europe, in the same cities as the Venetians and Genoese had formerly done; but this was not of any long duration; for the Dutch soon getting a footing in India, drew that commerce to themselves; and therefore had no occasion for depôts, at Bruges, Antwerp, or any other places in the north.

The persecutions of the Spaniards drove many of the most industrious of the inhabitants of the Netherlands into England and other countries. Thus the manufactures declined; and the Dutch, discovering a better method of curing herrings than had before been known, drew that trade, as well as that of India, to themselves.

The number and variety of the military undertakings in which the Hanse Towns embarked, contributed more powerfully perhaps than any of the causes above specified to accelerate their ruin. A general jealousy was raised; and the Kings of France, Spain, and Denmark, and several states of Italy, forbid their towns to continue members of the confederacy. Upon this, the Teutonic Hanse Towns restricted the confederacy to Germany,

and distributed its towns under four metropolitan towns,—Lubec, Cologne, Brunswick, and Dantzic. Brunswick and Cologne afterwards separated from them; several towns followed their example, so that about the middle of the seventeenth century, the confederacy was almost wholly confined to the towns of Hamburgh, Lubeck, and Bremen. They retained the appellation of the Hanseatic towns, and claimed their former privileges. Under the appellation of Hanse Towns they were recognised at the peace of Utrecht in 1715, and at the Definitive Treaty of Indemnity in 1805;—almost the last moment of their political existence.

REMARKS.

THE object in these historical sketches appears to be, to prove the great benefit of commerce to all nations; but in attempting to establish this truism, the following unqualified assertion is made; "*that all nations have increased in strength and power, or remain weak and abject in proportion as they have encouraged commerce.*" (See page 142.) To make this position good, an account of the Phenicians and the trade of Tyre, it is said (page 142,) "will sufficiently prove to what a height of glory, grandeur, and riches a nation is capable of attaining by the *sole* resources of commerce." After expatiating, however, on the opulence and splendour of that once celebrated city, and calling in the authority of Isaiah, who said that Tyre is the "queen of cities, of which the merchants are princes, and which has for traders, the most illustrious persons of the earth," the writer exclaims, (page 144,) "Such was the ancient Tyre *when she fell under the arms of Nebuchadnezzar*, after a siege of thirteen years." But the Tyrians, it is said, had retreated to an island which they strongly fortified, and continued a business so flourishing, that the loss of their city did not destroy either their "empire of the sea or the reputation of their commerce." The next paragraph, however, informs us, that this new city of Tyre, *trusting to her riches and puissance*, dared to resist Alexander the Great, and

her temerity drew down upon her the utmost vengeance of the conqueror, by whom *Tyre was entirely destroyed.*" Thus ended the boasted wealth and riches, the opulence and power, the greatness and glory of the commercial city of Tyre.

It is rather unlucky, that the Tyrians should have wound up their accounts so unfavourably for themselves, and not a happy illustration of the position; as the reader may be apt to suspect that *all* nations have *not* increased in strength and power, or remain weak and abject in proportion as they have encouraged commerce: But what is still worse, the Carthaginian traders, with all their wealth and riches, shared a fate similar to that of their Tyrian predecessors; and if we approach nearer to our own times, and review the famous Hanseatic League, we will find from indubitable authority, that the gains of commerce are not the sinews of the state.

Mr. Oddy ascribes the downfall of the Hanse confederacy to their becoming warlike, and "preferring political importance to wealth obtained by their original modes;" but does not the experience of all history teach us, that no nation can long enjoy the blessing of peace, and commercial states are more exposed to the hostility of their neighbours than others; for the multiplicity of their concerns, the extent of their transactions, and we may add, the restless nature of commerce, which searches in all seas and pervades all countries, must interfere with the policy of foreign nations, or clash with their interests; hence irritation arises, which frequently terminates in open war. It is probable, that no system of policy, however wise or moderate, could have prevented the wars in which the Hanseatic League were involved; but we are sure, that most of them were undertaken in defence of their trade, or to repel the encroachments of their neighbours, whose envy and jealousy were excited by the showy but unstable wealth of these cities; and their fate, like that of Tyre and Carthage, affords a convincing proof that something more substantial than commerce is requisite to maintain the independence of any nation.

Another proof of the weakness of the assertion, that "commerce alone is sufficient to insure greatness," is derived from the

fact with respect to England. Were she to adopt the premises and conclusions of the author of the preceding paper, and to reason from analogy, or were she to rest on the extent and magnitude of her trade alone, she might justly dread the threats of Napoleon, and tremble for the duration of her empire. Tyre and Carthage were denied an extensive and productive territory, and could boast of nothing but their ships, their warehouses, and merchandise, while England can add to these, the vast resources of her agricultural industry. The combination of agriculture, manufactures, and commerce, is the true cause of the greatness, the opulence, and the power of Britain; it ought therefore to be the policy of the rulers of that country to guard the progress of these great branches with the same fostering care and protection, to encourage each without depressing the other, and to watch their reciprocal bearings, connexion, and affinity, that the general interest may be promoted, and the resources consolidated into a mass of strength adequate or superior to the power of her enemies. The same policy should be adopted by the United States.

It is scarcely to be expected, that any state whatever can enjoy undisturbed commerce for a length of time, or that it can avoid falling a victim to the avarice, envy, or rapacity of its neighbours, unless it be in a situation to maintain its rights; for not withstanding the law of nations, the faith of treaties, and the sanctity of regal compacts, yet these we find, are but feeble barriers against force and the turbulent passions of men; for the arm of power, supported by military skill, has ever decided the destinies of empires; and justice, humanity, and truth cannot shield the weak from the aggressions of the strong.* This was exactly the case with the Phenicians, the Carthaginians, and others, for they were possessed of no resource but that which arose from commerce, and it was to be seen only in their elegant palaces, their splendid dresses, and luxurious banquets. They wanted a hardy peasantry to defend them from the inroads of less wealthy na-

* The depredations of England and France on American commerce; the impressment of our seamen, the murder of our citizens in our own ports by their ships of war, and the attack on our national vessels in our own waters, all prove the truth of the above osition.

tions, they wanted the real sinews of power, for their whole exertions were directed to the attainment of the refinements of life, rather than to the productions of the earth, and their territory was limited to the walls of a city, the inhabitants of which, had to draw their precarious support from others by means of their trade. War must be ruinous to such states, as it impedes commerce, on which hinges their very existence. With resources so limited, it is not to be wondered that Tyre should fall before the hero of Macedon, or Carthage before Rome. The Scipios knew well where Carthage was vulnerable, and they carried the war to the gates of their city—it was there she received, and was unable to withstand the blow—it was there that her gold and her glittering toys were unavailing.

It is different with Britain; indeed there is no parallel, for her people possess a highly fertile country, which is capable of maintaining great armies, and affording all the necessary supplies for war; but it is too common to ascribe her prosperity solely to her commerce, entirely overlooking or not properly appreciating the value of her agricultural industry. This delusion in some measure proceeds from a misconception of the nature and consequences of foreign trade, arising principally from a comparison of the amount of the nominal price of their export and import commodities.

It must be extremely difficult to establish any data for ascertaining the profit on commerce, as the advantages derived from it are blended with the produce of land, and with manufactures; and the whole form an aggregate, that constitutes the wealth of nations. It is not easy to separate objects so intimately connected; but when we allow that commerce, by the intercourse it induces, contributes to civilize mankind, and to diffuse knowledge, with all those refinements which spring from human ingenuity, we raise its value higher in the scale of importance, than the rigid calculator who estimates its benefits by pounds, shillings, and pence. But whatever may be the profit on foreign commerce, its fleeting and precarious nature greatly diminishes its value to any nation, and in no respect, can it rise to a comparison with agriculture or internal trade; for the protection of commerce, is maritime power, or

naval superiority, which again depends on many contingent circumstances, often beyond the control of the most watchful precaution; and within our own times, we have seen the commerce of France, of Spain, and of Holland, annihilated by the bravery of British seamen. On the other hand, the empire of China is a happy illustration of the stability of the beneficial effects which result from internal industry; for her exports and imports are trifling and unimportant when compared with her immense wealth and numerous population; and yet her prosperity has already continued for a period of ages more remote than the records of Europe.

There is nothing of more importance to any country than a clear and distinct acquaintance with its own resources, as it enables the government and people to pursue those objects which conduce to their prosperity and happiness; it is therefore our duty, on all occasions, to inculcate true principles, how disagreeable soever they may be to the selfish and interested, and it is only by fair and free discussion that we can ever arrive at just conclusions; but to question generally received opinions, is always an ungracious task, as the inquirer has to contend not only with the subtility of argument, but with the passions and prejudices of men. It would therefore be no easy matter to convince the great and respectable body of merchants in England, or America, that commerce is only of secondary importance to a nation, and that her wealth and power are principally derived from the fertility of her soil, which is the basis of all her greatness, and the only sure foundation on which an empire can be raised.

By referring to the history of nations, the faithful records of all ages will present us with some indisputable truths; and there is nothing more certain than that commercial states have always been ephemeral, or their greatness fleeting, and their splendour momentary; for commerce is easily removed, it is floating property that can be transplanted to any country, and the conqueror has generally carried it to his own, or established it on some favoured spot. But it is otherwise with agricultural improvement and the produce of the earth, for the warrior always respects it, as he is dependant upon it for supplying his armies, and enabling him to make new conquests. He must desolate an agricultural

country by fire and sword, and the extirpation of the people, or it will still continue great and flourishing; but it has oftener happened that the conqueror has assimilated with such a country,* as in the case of the Tartars and Chinese; and how often have the Netherlands been overrun by hostile armies, yet they are still a prosperous country, by means of the fertility of the soil and the industry of the people. The improvement of the land, and internal industry, may therefore be held preeminent to foreign commerce and the other pursuits of mankind; and *that* nation must be great and powerful which directs its exertions to such objects.

ACCOUNT OF MAKING SPANISH WHITE AND PARIS WHITE.

[*By a Manufacturer.*]

SPANISH White is nothing but chalk, ground generally in tubs, the bottom of which is paved with small stones of a hard quality, or has one large hard bed-stone instead thereof, and a stone on edge is fixed to an upright axle, both which go round by the means of a water-wheel, steam-engine, or horses.

The chalk is broke into small lumps about four ounces each, and thrown into the tub in which it is ground, but the tub is previously charged with a large quantity of water, and as the grinding operation commences, the chalk unites with the water, its finer particles rise to the surface, and as a small stream of water is constantly running into the tub, and fresh quantities of chalk

* Many thousands of the soldiers of the Prince of Hesse Cassel, hired to England to assist in the reduction of America, preferred remaining here to returning home, after the revolutionary war. The case is not exactly parallel with that of the Chinese and Tartars; for the Hessians had their choice to stay or return. The Prince was not anxious for their return, as he was thus saved the expense of transportation, and he had men enough left for future contracts.

are added, the level of the mixture rises to a certain height, finds its way through an aperture of the tub near the top, and is discharged into a large reservoir, by which the two operations of grinding and washing are performed at the same time with a small expense. After the ground chalk has stood a sufficient time to subside, the water is run off, and the chalk being so stiff as to cut with a spade, is then removed to a place to dry, either by the air or by stove heat: the former of these is termed *stiffening*, the latter is called *drying*, and is the finishing process.

Chalk taken into the north coasts of England, at the chalk wharfs on the Thames, about 2*s.* 6*d.* per ton, and when made into Whiting in the North, sells from 16*s.* to 20*s.* per ton.

French Whiting, or Paris White, has not been made in England above 50 or 60 years; the manufacture of it was brought by a Dutchman, who settled in a sea-port town in Yorkshire, and who, by it, and his mode of refining and depurating rapeseed oil, and linseed oil, acquired a large fortune, and became a respectable banker.

ON BLEACHING.

THERE are three methods—The Dutch, the Irish, and the new or French method.

The Dutch method is very particularly described by Lewis Cromelin, and copied by the late Dr. Home and the compilers of the Encyclopædia Britannica. As each of the methods in the first and the last parts of the process coincide, it is unnecessary to describe each at full length.

The first operation is steeping in warm water, of the temperature of 180° of Farenheit's thermometer; bran is often added to promote the fermentation brought on by the dressing used by the weavers; the fermentation appears by the air-bubbles which rise to the surface, by the swelling of the cloth, and the scum which rises to the top; this fermentation is acid, and accelerates the pro-

cess of bleaching; it continues thirty-six or forty-eight hours; when the scum begins to fall, the putrefactive fermentation commences; the cloth is then drawn, washed, and laid on the grass; when dry, it is fit either for the Dutch or Irish method of bleaching.

Before we attempt to account for the effects of bleaching stuffs, and before we determine which method is to be preferred, we should ascertain the properties of the colouring matter of linen and its solvents. With this intention Mr. Kirwan took five quarts of burnt ley, in which yarn had been boiled,* added two ounces weak marine acid; this did not occasion any effervescence, but a deposition of a sediment of a greyish green colour, which was insoluble in boiling water; when dried it assumed a shining black colour, but internally it remained of a greenish yellow; it weighed one ounce and a half; it was insoluble in oil of turpentine, or linseed oil; it communicated a brownish tinge to the sulphuric and marine acids, and a greenish to the nitrous; it was not sensibly diminished by either of them.

He then dissolved one ounce of sweet barilha, Dantzic pearl-ash, Cunnamara kelp, Cashup and Clark's pearl-ash, in six ounces of pure water each, and digested eight grains of the green colouring matter in an ounce of ley made from each kind of those ashes in the temperature of 180° during three hours and a half. Two ounces of the barilha ley, one and a half ounces of the Dantzic, one and one-half ounce of kelp, one ounce of the Cashup, one ounce of Clark's dissolved the whole. He found that liver of sulphur is of all alkaline compounds the most powerful solvent of the colouring matter; hence, kelp which contains it, affords a ley which may be advantageously used in the first process of bleaching; so may the solutions of Cashup, and markoff, and artificial sulphurets.

The caustic vegetable alkali is most powerful, next to liver of sulphur; next to this, caustic mineral alkali; mild mineral and mild vegetable alkali occupy the last place. Solution of Windsor soap dissolved a very small quantity, and lime water scarce any

* Transactions of the Royal Irish Academy, vol. III.

are added, the level of the mixture rises to a certain height, finds its way through an aperture of the tub near the top, and is discharged into a large reservoir, by which the two operations of grinding and washing are performed at the same time with a small expense. After the ground chalk has stood a sufficient time to subside, the water is run off, and the chalk being so stiff as to cut with a spade, is then removed to a place to dry, either by the air or by stove heat: the former of these is termed *stiffening*, the latter is called *drying*, and is the finishing process.

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* Transactions of the Royal Irish Academy, vol. III.

of it; as one pound of lime water contains about thirteen grains of lime, its solvent powers must therefore be very weak.

Any ash ley may be converted into solution of liver of sulphur, by adding to it, when boiling, of sulphur one-twentieth part of the weight of pure alkali contained in it.

The DUTCH method consists in steeping the cloth in warm ley, but not boiling it, as the Irish do; this operation is performed in the following manner; different kinds of ashes, such as blue, white, pearl, markoff, Cashup, and Muscovy ashes are dissolved in water, with a few pounds of soft soap. The cloth is brought in dry from the green, and put into a large vat, the ley at a 100° is thrown on it, when it continues a few hours in this steep, the ley is drawn off, and then heated to 180°; this is repeated six or seven hours, and the degree of heat gradually increased till it is at last thrown on boiling hot; when the cloth hath remained in this three or four hours, the ley is let off and thrown away.

The cloth is then laid on the green and watered for six hours, afterwards it is allowed to lie till white spots appear on it before it is watered; next day it is watered twice or thrice, if the weather is dry; the third day it is lifted and passed through the same course of bucking as before. This alternate course of bucking and watering is repeated ten or sixteen times, before it is fit for souring. After souring, it is rinsed, mill-washed, and rubbed by women's hands, in soap and water; it is then sent to be bucked in ley rather stronger than formerly, which is gradually increased in strength till the cloth is of a uniform white, then the ley is weakened gradually, every course of bucking, till the process of bleaching is finished.*

The IRISH method commences as the Dutch, with macerating in warm water, thirty-six or forty-eight hours† (the degree of heat of the water is lower when the temperature of the air is warm, higher when cold) it is then washed, grassed, and boiled alternately, till fit for the sour and the boards.

* Home's Experiments on Bleaching.

† If burnt ley is used in this steep, it will stain the cloth and prevent the acid fermentation of the dressing, which if encouraged, would dissolve the alkaline compound, precipitated upon the yarn, at the time of boiling.

As the extent of our manufacture prevents the practice of watering, the ley is washed out of the cloth after each boil, before it is exposed to the sun and air: this should be done with the utmost care in warm weather, else the alkali may crystallize on the cloth and make it tender.

As this is the part of the process in which the Dutch and Irish methods differ, the subject is of material importance; the improvements in the arts enable us to determine a dispute which has continued one hundred years.

We have seen that the principal part of the colouring matter of linen is a resin, which, like lac, is insoluble in water, and in oils; but can easily be dissolved in alkaline caustic leys; heat promotes the action of solvents upon lac. A high degree of temperature greatly promotes and assists the action of alkalies upon the colouring matter. This, and some other facts mentioned hereafter, are in favour of the Irish method of bleaching.

Bleaching by alkali, purified of carbonic acid by lime, assisted by a high temperature, has been long practised in secret in the Levant; it is now practised as a recent and valuable discovery, and was first published by Chaptal. In this method, a small quantity of ley is put into the bottom of a boiler. Cloth or yarn steeped in the same kind of ley is loosely thrown into the boiler, and suspended in it on racks or grates of wood; it is closed with a steam-tight cover, and to prevent accidents from the violent expansion of steam in a high temperature, a safety valve is attached to it. Heat is then applied a few hours, the steam and heat are equally diffused, penetrate the fibrous texture of each thread, increase the solvent power of the alkali; the colouring matter is completely and speedily united with the ley, and easily removed by washing. As the action of soda upon cloth, even in its pure and caustic state, is less violent than the action of pot-ash, our attempts to bleach in this way, should commence with ley of soda, and our first essays should be on a small scale.

The apparatus for bleaching with caustic alkaline vapour is described by Chaptal, and improved by O'Reilly in his Essay on Bleaching; a description and drawing of it are in the 10th vol. of the Philosophical Magazine.

A small boiler is set in a furnace, on count Rumford's plan, and a cut stone dome like an oven, erected above it; this is furnished with a steam-tight iron door, armed with a safety valve; in this dome two reels for winding up pieces of cloth are fixed, like common reels, to turn vertically. In the inside of the boiler two rollers are fixed, one near each reel; when a number of pieces of linen or cotton cloth are connected and wound upon one of these reels, an end of one is drawn under the rollers, and attached to the other reel, on which there is no cloth; when this reel is turned, it draws the cloth off the first, and so on the contrary. The cloth being freed from the dressing, in the common way, is immersed in alkaline caustic ley, wound upon one of the reels, passed under the rollers, and attached to the other reel; the boiler is then filled eighteen inches deep, with purified ley; this covers the rollers and that part of a piece extended under them. These rollers are so fixed that they can be unhooked at pleasure, and the cloth passed through the ley in the boiler, or through the steam only, as the operator chooses. The workmen continue to wind the cloth off-and-on those reels for two or three hours, about which time the colouring matter is sufficiently dissolved. It is then washed, immersed in the oxygenated muriate of lime, exposed three or four days on the grass, steeped in diluted sulphuric acid, and finished.

This method has been practised in manufactories of printed cottons, where it is necessary to bleach out the stain of madder, from every part of the piece, except that part where the figure is intended to remain.*

This process has been recommended for purifying linen and linen rags. These might be placed on frames, and exposed to the vapour of weak ley, the impurities with which they were charged would soon be dissolved, and by washing them in pure water, or in water slightly saponaceous, all the dirt would be removed, and complete whiteness obtained. This method is recommended to the managers of public hospitals; it would be attended with considerable saving, and completely destroy the power

* O'Reilly's Essay on Bleaching.

of infectious vapours, which might have been condensed upon the clothes of the sick.

The common bleachers have long had a confused idea of the powerful effects of a high temperature of ley upon cloth, which they have attempted to produce by hasty boiling without a cover, not considering that the temperature is kept low by the vapour or steam carrying off the heat with it, which the steam-tight cover prevents; in every operation of this kind a safety valve, as in steam-engines, is absolutely necessary; while it prevents the temperature from rising too high, it effectually prevents accidents. What would be the expense and trouble attending an apparatus where twenty thousand pieces were bleached in nine months?

If the cloth is wetted with ley, might not pure water be substituted for the ley, in the bottom of the boiler, or might not the steam from the ley in the bottom of the boiler be sufficient?

A steam apparatus for boiling cloth, has long been in use in Messrs. Stevenson's green, at Springfield, near Belfast; there is a boiler similar to that used in steam-engines, with a safety, a feeding, and a damped valve. An iron tube is connected with the boiler from which two tubes proceed, and enter near the bottom of two iron vats; each of these tubes is divided into three branches, within each vat. The tubes are furnished with cocks, by which the steam may be stopped from entering any of the boilers at pleasure; near the mouth of each vat there is a flanch, on which a metal cover rests, at the time of boiling; this great cover is laid on and taken off by the same crane, by which the cloth is raised out of the vats after each operation. This apparatus might be regulated so as to produce any necessary degree of temperature, and might be easily applied to the eastern manner of bleaching, by steam. It is attended with many advantages, it is a security from the fracture of cast-iron boilers. The steam supplies the waste occasioned by the evaporation from boiling in the common way, and prevents any part of the cloth from drying in the boiler. It is a security against shot holes and other damages: it saves fuel and labour, and prevents the heat from escaping with the steam.

That a mixture of leys procured from mineral and vegetable alkalies is more effectual in dissolving the colouring matter than any of them separately, is an opinion generally received; wherefore, when our bleachers use pot-ash, they throw a bag of barilha ashes into the bottom of the boiler, not considering that the barilha contains charcoal, and that barilha and pot-ash are in a considerable degree caustic, and that hot leys in this state dissolve charcoal, which discolours the cloth, and requires a boil in pure caustic ley to extract it; every kind of ashes should be used in the form of ley, and ley should be purified from carbonic acid, with lime, and made with pure cold water. The degree of strength of these leys is determined by the taste; it would be more accurately done by a glass hydrometer, when immersed in vegetable alkaline ley; but as mineral alkalies contain neutral salts, in different proportions, this standard is uncertain. This aluminous test is most perfect.

The cloth being macerated in warm water, washed, and exposed on the grass for two days, it is boiled, washed, and laid on the grass for two days; then again boiled. It is thus alternately boiled, washed, and exposed on the grass, till fit for the sour. This method is now generally practised in Ulster.

SULPHURETS.

Mr. Kirwan's experiments on the colouring matter of linen-yarn on the alkaline substances used in bleaching, proved, that liver of sulphur is of all alkaline compounds the strongest solvent of the colouring matter. Ley of caustic pot-ash may be reduced to a solution of liver of sulphur, by adding to it, when boiling, one-twentieth of its weight of the alkali contained in it. The sulphur leaves a stain upon the cloth, which is very easily removed, by boiling it in pure alkaline caustic ley.

The high price of ashes in times of war, and the effects of lime upon sulphur, similar to those of alkalies upon it, suggested the idea of substituting the sulphuret of lime for sulphuret of pot-ash, in bleaching. Mr. Higgin's experiments* confirmed this opini-

* Essay on the Theory and Practice of Bleaching.

on. The sulphuret of lime is made thus: Mix four pounds of powdered sulphur with twenty pounds of quick lime, pour gradually on them eight or nine times their weight of boiling water. The heat and ebullition occasioned by the union of the lime and the water is sufficient to form the sulphuret. When the ebullition ceases, the lime, which is not united to the sulphur, subsides; the mixture is to be well stirred and allowed to settle, the clear solution is then drawn off, and more water added to the deposite, till the whole of the solution amounts to sixty gallons. It may be prepared by boiling four pounds of sulphur in fine powder, and twenty pounds of lime, slacked and sifted, in sixteen gallons of water for half an hour; soon after the agitation of boiling is over, the insoluble matter falls to the bottom, the clear solution is drawn off; water is to be added from time to time to the undissolved deposite in the boiler, and taken off clear till the solution of sulphuret amounts to sixty gallons.

As quick-lime attracts moisture and carbonic acid with avidity, it is kept pure with great difficulty, wherefore a bleacher at a distance from lime kilns may preserve it, in the form of putty, and in making the sulphuret, he may take twenty-five pounds of it, and four pounds of powdered sulphur, and boil them half an hour in twenty gallons of water. The operation is to be pursued as above, till the solution amounts to sixty gallons. The cloth purged of the dressing, is steeped twelve hours in this solution, washed and exposed to the sun and air, and the same operations repeated, till fit for the boards and acid steeps; boiling in this solution has been tried, but with no better effect than cold steeping; boiling in alkaline caustic ley, hastens the process and dissolves the remaining sulphuret, which may have given a disagreeable tinge to the cloth. This method recommends itself by promising to save fuel, alkali, and soap.

LIME.

Steeping in a mixture of quick-lime and water, of the consistence of milk of lime, has been successfully tried. The cloth is put into it when brought to a scalding heat, to 200°, and macera-

ted without any additional heat, for twelve or fifteen hours; it is then carefully washed, opened, and hanked, and again washed; then exposed to the sun and air; after three such manipulations, it is boiled in ley and grassed, till fit for sour and the boards; severe laws against the use of lime in greens, in Ireland, have greatly retarded the progressive improvement in the art of bleaching.

Authors, on this subject, have not recommended the practice of bleaching with quick-lime, but have generally written with severity against it; wherefore, the act prohibiting the use of it in bleach-yards is continued; but no practice has been more warmly recommended by eminent authors than bleaching with leys purified, or made caustic with quick-lime.

The late Dr. Black, of Edinburgh, who received the first rudiments of his education in Belfast, demonstrated in a paper he published in the second volume of the Edinburgh Physical and Literary Essays, that the mildness of lime-stone, chalk, and marble, is owing to an elastic fluid contained in them, and that when this is expelled from them by fire, they are converted into quick-lime; to this fluid he gave the name of fixed air; the French school has given it the name of carbonic acid gas. He likewise demonstrated, that the same kind of fluid is the cause of the mildness of some alkalies, and when it is expelled from them by heat, or attracted from them by some substance which has a greater attraction for them, they become hot, more caustic to the taste, and their attractions for oils and resins is greatly increased. The attraction of quick-lime for this air is greater than the attraction of alkalies for it; therefore, whenever quick-lime is mixed with alkalies in making ley, as for soap boiling, it attracts the air contained in the kelp, and leaves the ley caustic fit for making soap and bleaching.

Many prudent bleachers in this province, imitated the soap-boilers in making leys, fifty years past; but the trustees, and several prudent bleachers, were prejudiced against it. But, in the year 1766, the late Dr. J. Ferguson, of Belfast, published an excellent experimental Essay upon the use of leys and sours in bleaching, in which he has greatly elucidated this subject. With the in-

tention of teaching bleachers to ascertain the quantity of carbonic acid fixed in ashes, and in lime-stone, and consequently of ascertaining the proportional quantity of lime, from different kinds of stone, which should be mixed with any quantity of the different kinds of ashes, and which would require all the gas contained in them, to restore the lime to a mild insoluble state. He ascertained the quantity of the gas in each kind of stone, and in each kind of alkali he had an opportunity of trying.* Dr. Black, with the like good intentions, published an explanation of the effects of lime upon alkaline salt, and pointed out a method whereby it may be used with safety and advantage in bleaching. His method and conclusions are, one half of kelp that is commonly used will be sufficient, when sharpened with lime; twenty pounds of dry slaked lime may be mixed with every hundred of kelp; the same is said of cashup or markoff ashes. Spanish kelp, or barilha ashes will bear one half of its weight of lime, and then one fourth of this kelp that is employed at present, will answer the purpose. Pearl-ashes will probably require double or treble their weight of lime, and will become so much the more active and powerful, that they may be diminished to one fifth or one sixth of their usual quantity. Dr. M'Bride, formerly of Ballymoney, late of Dublin, wrote, for the benefit of bleachers, an abstract of these two Essays last mentioned.†

So small a quantity of quick-lime is soluble in water, as a six-hundredth or seven-hundredth part of the water. Leys used in bleaching cannot dissolve even so much. No danger therefore can arise, from using much more lime than the quantity prescribed.

SOAP.

Two or three kinds of soap only, are used in Ulster. First, hard white soap made of kelp or barilha and tallow. Second, hard

* If then leys free from fixed air, be most effectual in bleaching, does not the advantage appear of mixing so much lime with our ashes as is sufficient to attract the whole of their fixed air, and thus to bring them to their highest degree of perfection.

† These, with Dr. Home's Experiments on Bleaching, were published in Dublin, in 1771.

yellow soap, composed of soda, tallow and rosin; the rosin is added to render it cheaper; it is not used by our bleachers; the third is soft soap, made of pot-ash and fish-oil. It was long supposed that hard soap could not be made with pot-ash; we now make hard soap with it, by throwing common salt into the boiler.

Chaptal laid open to the world his discovery of a process of making soap from old woolen rags, and the refuse of woolen manufactures. Sir John Dalrymple, by a similar method, made soap from the muscular and cartilaginous parts of fat fish.*

SOURS.

The first sours used were butter-milk and infusions of wheaten or rye-meal; these are subject to three different stages of fermentation, the vinous, the acetous, and putrid. The acid continues to increase till the third commences, and with a rapidity proportioned to the temperature of the air. The period at which the putrid fermentation, which is hurtful to the fibrous texture, commences, is uncertain; wherefore, the mineral acids which are not subject to such changes, and which retard and oppose putrefaction, are universally used in Ireland.

When alkali attracts the carbonic acid from fire or from the atmosphere, it is not perfectly neutralized by it, but if this gas is thrown into caustic leys, it is attracted by part of the alkali with so much avidity, as to become perfectly saturated with it; this part is then insoluble in water, as leys have an opportunity of uniting with the carbonic acid, when cloth is boiled in it; this salt is precipitated on the fibrous texture, and prevents the farther action of the alkali upon the colouring matter. This obstruction is removed by some other acid which has a stronger attraction for the alkali than the carbonic, and which, when united with it, forms a compound salt, soluble in water; this is the object desired in sours. Dr. Ferguson, when speaking of this salt, uses the language of Dr. Home, then common among chymists, and calls it an earth, because it was insoluble in water; he clearly de-

* Both the above processes are given at large in the Phil. Mag. and Repertory of Arts of London. EDITOR.

scribed its qualities, and the method of obtaining and dissolving it.*

Any of the mineral acids dissolve this salt, but that which is very antiseptic, at the same time effectual and cheap, is the acid of vitriol; so called, because it was obtained from green vitriol, commonly called copperas, by distillation in earthen retorts made of fire clay; the residuum is colcothar.

It was long obtained for medical purposes, by burning sulphur, under a bell-shaped glass; the coldness of the air condensed the vapour, which trickled down the glass, into a broad glass dish, placed below it. In a large work erected near Lisbon, in 1764, it was obtained by burning sulphur and a small quantity of nitre in large glass globes. These were expensive, and on a small scale; they gave place to great leaden chambers, in which the fumes of the burning sulphur are confined and condensed.

A quart of dephlegmated sulphuric acid, should weigh three pounds and three quarters; it is very seldom more than three pounds and a half. Ten naggins of such acid, are sufficient to make two hundred gallons of sour, of a proper strength for eighty pieces of yard-wide linen. I am assured that a quart of the sulphuric acid manufactured in Ulster, generally weighs more than three pounds eleven ounces, which the bleacher will consider when he measures the acid.

If the sour taste has been destroyed when the cloth has been six hours in the steep, too much of the acid has not been used. If the sour has been long delayed, a moderate quantity of it is insufficient to saturate the insoluble compound; but when sours are often repeated, and the same quantity of acid used, the part of the acid which is not saturated will act upon the fibrous texture and make it tender; each succeeding sour should be weaker.

The first sour should be tried with a hydrometer; if it loses its acidity by the salt attracted from the cloth, too much acid has

* It was proved in the thirteenth experiment, that some earth was precipitated from a ley, by its absorption of fixed air. As part, therefore, of the alkali becomes insoluble, it in part precludes the action of succeeding leys; it is necessary to take this earth out of the cloth, and this can only be done by the use of acids. *Experimental Essay.*

not been used; sour a little stronger, which raising the hydrometer a little higher, may be fixed upon as a standard for other sours, after an equal number of boils in ley of the same strength. When sours are long deferred, the alkaline compound precipitated upon the cloth, precludes, in a great measure, the action of succeeding leys; sours should be early applied, and they should not be again used till after some intervening boilings, and as heat increases the active power of solvents, the operation of sours applied warm, would be more expeditious and effectual. When linen is drawn out of the sour, it is washed, scalded in soap ley, soaped, rubbed, boiled, washed, and exposed on the grass. These manipulations are repeated, in Ulster, till a due degree of whiteness is acquired.

SMALTS.

In the last scald a small quantity of indigo is sometimes added; but indigo reflects a tinge too dark. The well known blue of laundresses is preferred and generally used. This is made from a metallic ore, or oxide, called cobalt, found plentifully in Saxony; when this ore is roasted, it is called zaffer; when this is fused with three parts of sand, and one of pot-ash, the product is blue glass; which, when pounded, sifted, and ground in mills, form smalts. That the blue may be obtained of various degrees of fineness, the smalts are agitated in casks filled with water, and pierced with openings at different heights. The azure brought by the water of the three different cocks, forms the different degrees of fineness, known by the names of azure of the first, second, and third fire; the second cock sends out azure of a very good quality for mixing with starch.

Saxony and Bohemia were long exclusively possessed of smalt-works. By the exertions of Compte de Beust, the French had divided the trade with Saxony; the Compte has found near the village of Juget, a quartz sufficiently charged with cobalt, which when fused for smalts, requires no additional quantity of the ore. Smalts are sometimes adulterated with hair-powder, which is easily detected by mixing them with water, the starch continues mixed with the water, the azure falls to the bottom.

When linen was starched, it was dried on the grass, or on hedges; but Mr. J. Nicholson, of Lawrence-town, on the Upper Bann, in the year 1727, demonstrated, that it was more conveniently and more perfectly done, in houses and lofts constructed for the purpose.

THE METHOD OF MANUFACTURING BLEACHING MATERIALS, IN ULSTER.—BY DR. S. M. STEPHENSON, OF BELFAST.

From the Belfast Literary Society.

When this great mechanical apparatus, (erections and engines for bleaching) is constructed at eligible falls of water, and placed in suitable houses, in one of which two boilers, with convenient racks and keives are set, the bleaching stuffs or materials are to be provided. The principal are fossil and vegetable alkali, lime, sulphur, soap, acids, pure air and manganese.

The fossil or mineral alkali, when purified and crystallized, is now called sal sodæ; it is called natron when found native, as in Egypt, Syria, and India, countries famous for the early manufacture of fine linen; this, or water impregnated with it, was probably, after pure water, the first bleaching material. Sal sodæ is procured in this country, [Ireland] from almost every kind of sea-weed, as fucus serratus, vesiculosus and nodosus. The last, the knotted fucus, which has long slender stalks, leaves small bulbs or vesicles in the middle of the stalk, vulgarly called eel-wrack, is most esteemed by our kelp-makers. In the months of June and July, these, and other sea-weeds, growing upon the stones and rocks of our shores, are cut with hooks; if the weather is very dry and warm, the wrack is laid upon the dry shore, in small heaps, and allowed to continue in them without stirring, till it is fit for burning; if the weather is cold and damp it is spread out to dry, and then gathered into heaps, in which it is allowed to lie till it grows regularly damp; it is then burned in kilns; these are built upon dry hard ground, with square stones, without cement; they are generally fourteen feet long, three feet

wide, and eighteen inches high. When the wrack is in a fit state for being burned, a fire is kindled in the bottom of the kiln; the wrack is slowly and regularly added till the kiln is filled with red hot ashes, which generally happens in six or eight hours. About this time bubbles are seen among these ashes; the kiln is then struck, the ashes are briskly stirred, or struck with small iron rakes till they assume the appearance of scoriæ of iron fusion, more weed is then added, and the same operation repeated till the kiln is entirely full. When cold, the walls are removed, and the kelp is broken into great square blocks for the market. Price, four or five guineas per ton in time of peace; it is dearer in time of war; at present about 15*l.* Men's wages for cutting and burning, 1*l.* 5*s.*; when it is made in distant islands, 1*l.* 12*s.* 6*d.*

Kelp was long esteemed an excellent bleaching material, but when farmers employed labourers to make it by the ton, they soon found, that sand thrown into the burning kiln increased the solidity of the kelp, and added to the weight. The greatest evil arises from the alkali fusing the sand, and forming a frit like that of which green glass bottles are made, which, though in some degree soluble in water, is not a good bleaching material.

The sal sodæ is found in ashes procured from various kinds of kali, especially from the sal sola vermiculata frutescens foliis ovatis acutis carnosis of Linnæus; named by French writers, kali Hispanicum, because the best is found in Spain, near Alicant, at some distance from the sea. This plant is cultivated, for this purpose, in different countries. It is found in the county of Antrim, at Carnelagh, near Glenarm. Soda is procured from salicornea and chænopodia. The sweet barilha from Alicant, is reckoned the best; but that which we import from Sicily contains the greatest quantity of the sal sodæ, and is most esteemed by soap-boilers.

As mineral alkali is the basis of common salt, it may be decomposed after the method of Mr. Turner, in the manner he makes patent yellow; or of Mr. Kirwan,* by mixing boiling solutions of purified common salt, and of sugar of lead; in this

* Transactions of the Royal Irish Academy, vol. iii.

mixture there is an exchange of the acids. The acid of the sea-salt unites with the lead, and the acid of the sugar of lead unites with the mineral alkali of the salt; by evaporation large pellicles of acetous soda may be obtained; when this is heated in a crucible to redness, the acid inflames, the alkali remains in the crucible; in this process nothing is lost, for the lead may be revived, or turned into a pigment.

The vegetable alkali is obtained more or less by combustion from all vegetables; it remains in the ashes; it is the basis of salt petre, and of cream of tartar, and is easily obtained by mixing and burning these substances, in the proportion of equal parts, when pure. As this substance is of vast use in many experiments and manufactures, chymists have attempted to determine the quantity which may be procured from different kinds of trees and weeds. The French have determined that the greatest quantity is obtained from horse-chesnut; of weeds, fumatory and wormwood produce most. The vegetable alkali is known by different names, generally taken from the state of purity in which it is, or from the country from which it is sent. As Russia ashes, Dantzic pearl, Cashup, American pot, and American pearl.

The vegetable matter, as weeds, leaves, and branches of trees, are gathered before they seed, dried and burnt in an open fire; in countries abounding in wood it is burnt for culinary purposes. The ashes are carefully collected and kept dry, till they are lixiviated; this ley is poured off and evaporated in large iron pots, and the heat is continued and increased till the saline matter is melted; when cold, it assumes a great degree of solidity; it is then of a dark grey or brown colour, and is called potash; by the French chymists potasse; by some of ours, potassa; by the London college kali, when very pure, salt of wormwood. It is called pearl ashes from the blueish white colour it assumes when treated in the following manner: Potash is put into a reverberatory furnace, the extractive matter which the ley has dissolved, and which has united itself to the alkali is burnt off. In this process it is not allowed to melt, but it is constantly stirred, and consequently attracts from the fire carbonic acid to saturation, as much as it is capable of attracting, that is, not less than thirty-seven

pounds in one hundred pounds of pearl ashes: adulterations of them with different kinds of salts, as sulphate of pot-ash, are detected by their not dissolving as pearl-ash, in their weight of water.

As none of these alkalies, even in their white and most beautiful appearance, are naturally perfectly pure, and as the alkaline part is that on which we principally depend for bleaching; tests for discovering the materials, especially the alkali they contain, have been long the objects of the attention of chymists.

As alkaline substances are known to effervesce, when acids are dropped into solutions of them, it was supposed that the alkali was in proportion to the quantity of acid expended during the effervescence; but as this effervescence arises from a fluid which is elastic, when not combined with another substance; and as it is often combined with other substances, which are sometimes combined with alkalis, and as some very good ashes contain very little of this gas; acids used as tests in this way are very uncertain.

As infusions of the blue or purple parts of vegetables, as of violets and leaves of red cabbages, are tests of the prevalence of acid or alkali in a mixture; paper tinged with one or other of these, is used to determine when the acid and alkali of the mixture becomes neutral. If alkali prevails, the paper when dipped into the lixivium changes to green; if acid, it changes to red: the proportional quantity of alkali, was found thus, in equal measures of ley made from equal quantities of different parcels. But as mineral alkali, when pure is capable of taking more acid to saturate it than vegetable alkali of the same degree of purity, this test is uncertain; the former will saturate more acid than the latter, in the proportion of forty-eight to twenty-two, nearly; wherefore if an acid test is used, attention must be paid to the kind of alkali tried, and calculations made agreeable to this proportion. The ashes which require most acid to saturate them are the strongest.

Mr. Kirwan has published, in the before cited paper, an account of an accurate test, consisting of solution of alum.

Alum is composed of sulphuric acid and pure clay; both the mineral and vegetable alkalis take the acid from the clay and pre-

cipitate it; but equal quantities of alkalis of different kinds, precipitate unequal quantities of earth of alum: one hundred parts by weight of mere vegetable alkali, precipitate seventy-eight of earth of alum; one hundred parts of mineral alkali, precipitate one hundred and seventy-one of the earth, nearly: nothing remains in the solution capable of dissolving this precipitate. The quantity of the earth of alum, taking into consideration the above qualities or the powers of the mineral and vegetable alkalis to neutralize these certain quantities of acid, and to precipitate these proportional quantities of alum, becomes a test of the quantity of mere alkali contained in any ley, except leys from mineral and vegetable alkalis mixed.

The method of making the aluminous test.—First, Take one pound of powdered alum, washed with cold water; pour on it three or four pounds of boiling water.

Secondly, Take an ounce of the substance to be tried, powder it, and put it into a Florence flask. If it is barilha or pot-ash, add one pound of pure water. If pearl-ash, or any alkali that contains little earthy matter, half a pound; boil for a quarter of an hour; when cool, filter it into another Florence flask.

Thirdly, Gradually pour the solution of alum, hot, into the alkaline solution, also heated, and a precipitation will immediately appear; shake and gradually add the solution of alum till the mixed liquor when clear, turns syrup of violets or paper tinged blue, with litmus or radishes, red; pour the liquor and precipitate on a paper-filter, the precipitate will remain on the filter; gradually pour on this, hot water, till it passes tasteless; when the precipitate is so well dried as not to stick to glass or iron, powder it in the cup in which it is dried; keep it for a quarter of an hour in a heat of from four hundred and seventy to five hundred.

Fourthly, Throw the earth thus dried into a Florence flask, and weigh it, then put about one ounce of spirit of salt into another flask, and place this in the same scale as the earth, and counterbalance both in the opposite scale; then pour the spirit of salt gradually into the flask that contains the earth; when all effervescence is over (if there is any) blow into the flask, and observe what weight must be added to the scale containing the flasks to

restore the equilibrium; subtract this weight from that of the earth, the remainder is a weight exactly proportioned to the weight of mere alkali, of that particular species; which is contained in one ounce of the substance examined; or, if a pound is tried in a pound, all besides is superfluous matter.*

NEW, OR FRENCH METHOD OF BLEACHING.

So far as we are acquainted with the history of this art, mankind, in all ages, have employed as auxiliaries, the sun and free air; how these operate is a question, for the solution of which we are indebted to the modern discoveries in chymistry.

The atmospheric air, for ages, was considered one of the four elements, but the celebrated Priestly discovered that it consists of several elastic gasses, different or opposite in their qualities; the air we breathe, the atmospheric air, besides many elastic substances contained in it, consists of one-fourth of an elastic fluid, which when separated from other gasses in the atmosphere, supports combustion and animal life longer than common atmospheric air. This substance has obtained different names, from different chymists, which are most agreeable to the qualities they first discovered in it, or to the ideas they had conceived of it; Priestley called it dephlogisticated air, because it had few of the qualities which air acquires on passing through fire. Scheele named it fire-air, from the power it has of supporting combustion. Lavoisier, air, eminently pure; Condorcet, vital; air, and Bergman, pure air.

As this elastic fluid has a power of forming combinations possessed of acidity, the name of oxygen is given to it, in the new nomenclature, from a Greek word, signifying sour or acid. In passing through fire and fermenting liquors, it combines with the substance of charcoal, (in the new nomenclature, carbon); it then forms an acid, the carbonic acid gas, which unites with lime and

* The precipitation of seventy-eight parts of earth of alum by vegetable alkali, denotes as much of this as the precipitation of 170 8 of that earth, by the mineral alkali. Kelps and pot-ashes, as they contain different sorts of alkali can only be compared together by means of the proportions above indicated.

alkalies, and renders them mild, and in a great degree inactive. Dr. Black separated it from many different substances, and first clearly described its principal qualities, and because it was fixed in some solids, named it fixed air, as has been particularly noticed.

Oxygen combines with the colouring matter of vegetables, reduced to carbon (charcoal) by alkalies, it assumes the elastic form of carbonic acid gas. The heat of the sun favours the combination, and by heating the ground, occasions a rarefaction of the adjoining air, causes it to ascend and give place to more distant, colder air; by this motion there is a constant successive application of oxygen to the colouring matter of flax. Dew is a powerful bleaching material, because water, especially in an elastic form, is capable of uniting with oxygen, and of giving it to the colouring matter.* Common herbage, consisting of a great variety of vegetables, give out pure air to it. If pure vital air in a more concentrated state, is applied to the colouring matter of flax, it will more speedily and perfectly hasten the process of bleaching; in this, the new, or French method consists.

The pure part of the atmosphere, oxygen gas, combines with metals, and forms oxides or calces of them. It combines with muriatic acid, and destroys its acid taste.

The combination of oxygen with manganese, on account of the abundance and cheapness of this ore, is of great importance; because, from it, oxygen gas is extracted and condensed for bleaching.

Manganese is brought to us in large, irregular, black fragments, resembling the ore of antimony, some brown spots are interspersed through it; the best is regularly crystallised in the form of small black, brilliant needles.

This substance has been long known to glass-makers, by the name of glass-soap, because when a small quantity of it is mixed with glass, in fusion, it removes the colour; when used in considerable quantity it changes the colour of the glass to purple or

* Berthollet exposed paper tinged with litmus, to dew, and found it so much saturated with pure air, that the colour was changed, and concluded, that the old prejudices in favour of May-dew were not without foundation.

garnet; when exposed to a red heat it emits pure air in considerable quantity; it is valuable in proportion to the quantity of this vital fluid which it contains.

This metallic oxide is largely diffued through the surface of our globe. It is found in quantities in Mendip-hills, near Bath;* it is finely ground in mills resembling these in which flint is ground for potters; in this operation it is often adulterated to one half the value; gentlemen who use much of this ore will purchase it in the gross, pound it, and powder it in mills attached to their own machinery.

When this oxide is digested in muriatic acid, a gas is disengaged of a yellow colour, and a peculiar suffocating odour. The acid loses its acidity by this combination; it has not a sour but a styptic, taste; it does not, as other acids, change the blue and purple of vegetables red, but destroys their colour.† It unites very sparingly with water.

To the ingenious and persevering experimental Swedish apothecary, Scheele, we are indebted for these discoveries, which he published in the Stockholm Transactions for 1774. This ore, powdered, was put into a retort, immersed into a sand heat, and muriatic acid added to it; in fifteen minutes the receiver was filled with yellow vapour, which had the qualities now mentioned. By it the flowers, and even the green part of vegetables were rendered pale and colourless. The liquor left in the receiver was changed into weak spirit of salt. His theory is, that a part of the acid dissolves the oxide; that from the solution pure air is expelled, which unites with that part of the acid, unconnected with the metal, and as pure air had gotten the name of dephlogisticated air, Scheele named this vapour dephlogisticated muriatic acid. The French chymists conceiving pure air, an acidifying principle, named it oxygen, and when this was united to muriatic acid they called the compound oxygenated muriatic acid, which was afterwards contracted into oxymuriatic acid.

* And in various parts of Virginia and Nova-Scotia. EDIT.

† If pure air contains the principle of acidity, how does it supersede the principal qualities of the muriatic acid, when united with it?

Immediately after this great discovery, the French chymists turned their attention to a substance which exhibits such singular properties.

Chaptal exposed old prints to the influence of this substance, from which they acquired a degree of whiteness they never before possessed; as he used it much diluted, it had no effect upon the printer's ink.*

Berthollet of Paris prosecuted this subject, and published an account of his investigations in the Transactions of the Academy, in 1785, and in the Physical Journal 1785 and 1786, and in the year 1786 he published the result of his inquiries and experiments in the second volume of the Annales de Chimie. This interesting paper has been translated into English, and published in Dublin for the benefit and improvement in the art of bleaching.

Before he attempted a complete investigation of the properties of this unknown noxious elastic vapour, he supposed uniting it to water, a necessary precaution. This he attempted to effect, by agitating this gas in a phial with water, supposing it would unite with it, as fixed air, carbonic acid gas, does; but the suffocating vapour which was exhaled, induced him to choose Woulfe's apparatus for his future experiments, of which there is a cut in the Annales de Chimie, Vol. II.

By this apparatus he forced the vapour to the bottom of the water in the first receiver, called an intermediate body, which attracted from it the uncombined muriatic acid; the oxygenated muriatic vapour ascended to the top of the water in the intermediate body, passed into another bent glass tube, which connected the first and second glass bodies, and there the vapour connected itself with the pure water; he found when the second glass body, containing diluted oxygenated muriatic acid was exposed to the rays of the sun, a profusion of bubbles arose to the top, which consisted of pure air, and that when all was disengaged, the glass body contained pure air and water slightly impregnated with muriatic acid; hence he concluded that oxygenated muriatic acid was nothing more than a combination of the muriatic acid, with the pure air or oxygen, extracted from the black oxide of manganese.

* This process is very neatly performed by Mr. Rasch, of Philad. Ed.

He tried to bleach thread and cloth with this liquor concentrated, he made them white and tender; then he tried it weak, he made them white, but by keeping or immersing them in ley they turned yellow; he then used the blanching liquid and ley alternately; lastly, he steeped in diluted acid of vitriol, and obtained a perfect white.

Mr. Welter constructed a simple and extensive apparatus for preparing the blanching liquid, on a large scale; this consisted of a small portable furnace, which contained a retort or a bolt-head, in which, and in an intermediate glass body, a bent glass tube was fixed. In this intermediate body there was a safety tube, and a tube for conducting the blanching vapour into a wooden receiver, nearly full of water, and well closed, in which there was an agitator turned with a crank horizontally; when the water was impregnated with the vapour, it was drawn off for use.*

The expense of using muriatic acid was so great that no manufacture could bear it, wherefore M. Berthollet conceived that muriatic acid could be extracted from common salt, by the acid of vitriol, and the pure air from manganese by the same process. Wherefore he took of powder of oxide of manganese, six ounces; of marine salt, one pound; of sulphuric acid, and of water, each twelve ounces. It is necessary to augment or diminish the quantity of manganese in proportion to the qualities of the oxide.

Immediately after the publication of Berthollet's Treatise, the new method was tried on the river Clarey. The workmen fell into the same mistake as the French in their first essays; they imagined they should produce an elegant white without any material but oxygenated muriatic acid. It did whiten the colouring matter to a certain degree, to half white, but no manipulations in the same liquid could whiten it better; when dipped in ley, it was changed to a dirty yellow. It required as many operations in the Irish method of bleaching, as if it had never been dipped in the blanching liquid.

The French chymists tried immersion in the liquid, and in caustic ley alternately; when the ley was brought to the boiling

* Annales de Chimie, vol. II. p. 163.

point they succeeded. The manipulations were always finished with a sour.

To prevent accidents which might result from too great strength of the liquor, a test for ascertaining the bleaching power of it, was founded by **M. Decroisille**; he took one part of indigo, reduced to fine powder, and eight parts of concentrated sulphuric acid (if the acid is much dephlegmated, seven parts will be sufficient) he digested this mixture in a matrass some hours, in a hot water bath; when the solution was finished he added water till the whole amounted to one thousand times the weight of the indigo used. **Mr. James Watt**, of **Birmingham**, found a good test in infusion or decoction of cochineal.

Before this test-liquor is used, the bleacher has provided a test-tube of glass, about twelve inches long, one inch or seven-tenths wide, funnel-shaped at the mouth, with a stand like a wine glass. If a tube could be found perfectly cylindrical, a scale equally divided might be cut upon it; but as this is next to impossible without boring or grinding, it may be divided mechanically, by putting into the tube, one hundred parts, suppose grains of rain or distilled water; the surface will show the place of the first cross line upon the tube, which may be marked 0; the part of the tube, although cylindrical, occupied by the hundred parts of water, is called the bulb. The scale is finished by adding from time to time twenty grains of water, and marking the surface of each for a degree.

The bulb of the tube is filled with the test-liquor; the blanching liquid, diluted as near as may be to the degree requisite for a steep, is added cautiously, till the mixture rises in the tube to one degree, then it is well shaken. This is repeated till the mixture is changed from blue to brown. The degree on the tube, at which the mixture rests, denotes the blanching power of the liquid. If it rests at one, it is the strongest, because least of the liquid blanches the test. If the colour is not destroyed till the mixture rises to the second degree, it is half the strength, and is then sufficiently diluted for the first immersion of coarse cloth. Each succeeding steep should be weaker.

Mr. Rupp, of Manchester, has improved the test-liquor, by adding acetite of lead (sugar of lead) to the solution till the lead is precipitated, and the indigo is united to the acetous acid.*

The use of the test consists not only in ascertaining the strength or the bleaching power of the liquid, but in determining the additional quantity which should be added to the ley remaining in the kieve, after the cloth is drawn, that it may be of the same strength as at first. If the first steep is of such strength as to require so much of it put into the tube, as shall raise the mixture to three on the scale, and, if, after the immersion so much must be added as to raise it to six, then half as much of the strong liquor first used must be added to bring it to the same strength as at first. The second steep of the same cloth should be so much weaker that the surface of the mixture in the tube may coincide with number four on the scale.

In order to determine whether bleached goods have been injured by the bleaching process; the manufacturers of thread and cotton hose, adopted the practice of running a line of vat-blue dyed very dark, or of Turkey-red, along the top of each stocking, and those bleachers only were employed who could render the hose perfectly white without effacing the blue or red stripes, or even lessening their intensity of colour. The hyper-oxy-muriate of lime will destroy indigo-blue or Turkey-red, if used of its full strength, and yet it may be so diluted as not to injure these colours, and will still be strong enough to bleach brown linens or cottons. The same practice has been advised to be adopted with respect to other kinds of linen and cotton goods. But a writer in a foreign publication, who styles himself a "Bleacher," objects to the test proposed, and says, "that he will bleach goods with both red and blue preserved, and the cloth will be rotten, though the colour be good; for instance, very often the bleacher, in the last finish, lets them lie in sulphuric acid water, tasting sour, then he rinses them out of that well, and dries them; now if they should

* The test with vitriol is inadmissible, in experiments upon the comparative strength of the bleaching liquor, with and without alkali, because sulphuric acid decomposes the muriate of potash.

not be properly washed, as I have seen, and dried with part of the acid in, it corrodes the cloth, &c. through time, and the red and blue stand the sulphuric acid well. Oxygen is a great enemy to vegetable colours, but being saturated either by alkali or lime, it in part preserves the colours, though it still acts on the brown colour of the cloth; but to bleach red and blue requires very great care to know what hurts them most, and to avoid it: for boiling with strong pot-ash reduces the blue very much, and many weak immersions to save these colours are expensive, and the bleacher can neither do them so soon or so cheap; likewise some dyer's blue and red will stand as well again as others; and for the heavy goods, as they have about Manchester, it would be almost impossible to bleach them without destroying these two colours, even out in the air; but goods that have been wove with half bleached cotton, the process is less, and they can be easier preserved. The same strength of oxygenated muriatic acid, that would take out the red and blue, by adding pearl-ash, will preserve it; but though the oxygenated muriate of lime was used as strong again as that which takes out these colours, it would not injure the cloth by proper management; the chief thing is to have the liquor settled well, and the goods lying no longer than necessary, and to *rinse well* before putting them into the sulphuric acid water; they should be boiled for the finish, out of pearl-ashes and white soap, and then rinsed and dried; for the boiling with the alkali destroys all the muriatic acid it might have imbibed. Weak alkali does not injure cotton, but I have seen in the beginning of the new process of bleaching, goods, that have not been rinsed and boiled out of the oxygenated muriatic acid, so rotten as hardly to hang upon hooks, beautiful Manchester marcellas, and dimity, owing to the ignorance of the bleacher in using it. The only way, in my opinion, which is the way that I do, is to take a piece of the end of the cloth between my two thumbs and two fore fingers, and let the nails of the thumbs press together, so as to have a purchase or power upon the cloth, and you may judge from that of the strength of the cloth, likewise you may judge by tearing it both by warp and weft, take notice how it tears, either with noise or otherwise; by attention to this, I

think the buyer might easily distinguish goods that are sound from those that are not; but to trust to colours is an uncertainty, for there is cotton yarn so rotten, that it can hardly be woven, and sometimes even the webs remain so long with the weaver's dress in them, and upon damp places, that they come to the bleacher half rotten before he begins upon them; but in my opinion the buyer should try the strength, which he will soon learn to know, by the above method, and that is the surest way."

The principal objection to the use of bleaching liquid, is the suffocating vapour rising from it in every operation. The last was successfully tried by making the kieve in which the cloth was to be steeped, partly filled with water, the receiver of the vapour; and having the cloth wound round reels in it; the agitation produced by the motion of the reels and of the cloth, is sufficient to produce a perfect mixture of the gas with the water, and with the colouring matter of the cloth.

Mr. Rupp has recommended the use of oxygenated muriatic acid in water alone, and has published an account of his experiments and apparatus in the fifth volume of the Memoirs of the Society of Manchester. This consists of an oblong deal cistern, in which two perpendicular axis are placed; a number of pieces of cotton connected together are wound upon one of them, the cistern is covered with a steam-tight lid, the liquor put into it, and the pieces wound from one axis to the other, till the liquor is exhausted.

As ley of potash absorbs the gas with great avidity, and retains it more obstinately than pure water, it is less dangerous to the workmen, and cloths may be wrought in it without danger, in open vessels; it is very much in use in cotton factories.

This lixivium is more expensive and less effectual than the oxygenated acid, mixed with water alone; because part of the acid forms with the alkali a salt known by the name of oxygenated muriate of potash, which is useless in bleaching, as it does not destroy colours*. When so much of the gas is thrown into the ley of potash as to destroy the bleaching power altogether, it is called hyper-oxy-muriate of potash.

* Berthollet's Memoires de l'Acad. de Turin.

The apparatus used in Ulster consists of a cast metal boiler, which contains water for a hot bath; a leaden pot with a close cover, called a still, instead of a glass retort is inserted in it. In this cover is a tube, through which an iron rod passes, which can be turned at the top; arms are fixed in it for agitating the contents of the still, all covered with lead. Near the boiler a leaden vessel called an intermediate body, partly filled with water, is placed. From the cover of the still, a leaden pipe issues, and turns into the cover of the intermediate body; from the cover of the intermediate body, another tube issues and turns into the cover of a large wooden cask, which contains water, or ley of potash, and is called a receiver; in this there is an agitator similar to that in the still; equal parts of common salt and manganese are put into the still, the cover is put on, and luted. Sulphuric acid equal in weight to the salt used, is diluted with its bulk of water, and poured through a bent leaden funnel, upon the other ingredients. The sulphuric acid unites with the alkali of the salt, the acid of it acts upon the manganese and expels pure air from it, which unites with that part of the muriatic acid vapour, unconnected with the manganese, and oxydises it. This vapour rushes through the bent tube into water in the intermediate body, which attracts the pure oxy-muriatic vapour, rushes into the ley and combines with it. The water in the intermediate reservoir arrests the portion of the muriatic acid gas, which escapes at the commencement of the operation, without being oxygenated, and also any sulphuric acid which might have chanced to pass.

In making the oxy-muriate of lime, an intermediate body is unnecessary; the only agitator is a wooden rake, the shaft of which moves in a tube, in the side of the receiver. Four pounds of salt, four pounds of manganese, and four pounds of sulphuric acid diluted with equal its bulk of water, will produce a sufficient quantity of oxygenated muriatic vapour, for one hundred quarts of ley, made with one pound of ashes.

The amount of alkalies annually imported into Ireland, in times of peace, is 215,307*l.** It is greater in times of war. The

* Higgins.

price of ashes, and the similarity of the qualities of lime and potash, suggested the possibility of uniting oxygenated muriatic acid with lime, in a fluid state; this method was first thought of in Ireland.*

Gas from thirty pounds of black oxide of manganese, thirty pounds of salt, and thirty pounds of sulphuric acid diluted with its bulk of water, was thrown into a mixture of sixty pounds of lime, suspended in one hundred and forty gallons of water. For this, Mr. Tenant, of Glasgow, claimed a patent; but it appeared he was not the original inventor. He then united the vapour with dry lime and obtained a patent for it, still in force.

Oxy-muriate of potash as it comes from the manufacturer, is diluted with thirty-five or forty waters before linen cloth is steeped in it. One pound of oxy-muriate of lime, in a dry state, is soluble in three gallons of water. It is necessary to add twenty-five gallons to this solution, before coarse linen is immersed in it, and more water if for fine cloth. As this is more effectual and more severe than oxy-muriate of potash, greater attention to the steep is requisite.

One large vat of fir is sufficient for the mixture of oxy-muriate of potash and steeping cloth; two vessels such as wine pipes are required for the operations of oxy-muriate of lime; one for dissolving the salt, the other for reducing it.

When either of the leys is thus prepared, cloth is loosely thrown into it and steeped from six to twelve hours. That it may be perfectly purged from the oxy-muriate; it is then well mill-washed, scoured, and scalded in solution of soap, washed, and exposed to the sun and air; it is then starched and finished. The cloth is generally so much bleached in the common way, by frequent boils in alkaline ley, that one steep is sufficient; if more is necessary, boiling in ley and exposure to the air are repeated, previous to each steep.

The French boil in ley, made in the proportion of one pound of pearl ash or potash, made caustic with lime, diluted with twenty quarts of water. It is washed and steeped three or four hours in the blanching liquid; these operations are alternately

* O'Reilly, Phil. Mag. vol. 10. p. 301.

repeated six or eight times, the cloth is then sufficiently prepared for the sour.*

Cloth, when it can be done, is subjected dry to every boil and every steep. The leys then penetrate the fibrous texture of the thread, are attached to the colouring matter, and dissolve it, and are washed away by pure water, or whitened by pure air; or, according to O'Reilly, reduced to carbon by alkali; the carbon united to the pure air of the atmosphere, or of oxy-muriates, becomes volatile, and escapes in the form of carbonic acid gas. When cloth is immersed wet, the bleaching leys should be stronger. But if cloth is submitted dry to the action of steam in a high temperature, it may be made tender, or dissolved by it.

Some adventurers from England and Scotland, pretending to great skill in the art, and to the knowledge of important secrets in it, came into Ulster, and offered their services, for which they claimed great rewards; whoever practised their schemes upon a larger scale, was greatly injured, the cloth was tender, it mildewed; our manufacture and the new method of bleaching was brought into disrepute by their practice.

Inattention to the strength of the liquid, to the operations of washing, scouring, and scalding after steeping in it, was the cause of these misfortunes. If cloth is exposed on the field, in the stormy months, it will be tossed and often torn; when the days are short and dark, very little benefit is derived from the atmospheric air, it is then subjected to the alternate severe action of leys and mills.

In the summer months the selvages often escape the action of the pure air, and are insufficiently whitened. The black specks formerly described, called firing on flax, and sprit in cloth, adheres to the fibrous texture, through the different manipulations to which flax and cloth are subjected, even till every other part of the thread is perfectly white. In all such cases, the new bleaching liquid, managed with caution, would instantly remove these evils, and preserve the fabric from more severe operations.

* Berthollet, in the second and sixth volumes of Annales de Chemie, and in the Art of Bleaching, by Pajot de Charmes.

Bleaching with oxy-muriates has been tried in paper manufactories. The rags of which the paper is to be made, or else the pulp into which they are reduced, are submitted to their action. This method has been generally relinquished, because paper improved by it in colour, has, in a very few years, impaired the colour of the ink; even printers' ink has been known to fade by the action of the oxy-muriates remaining in it.* These detergents act upon the iron of the cylinder, and occasion iron-moulds. Washing with profusion of pure water in the engine, would remove the remainder of the bleaching liquid, but this would be attended with more trouble and expence than the old method. If paper manufacturers will imitate the method of bleaching described, they will be successful.

Let them attach a small wash-mill, on the plan of the old tuck-mills, to their machinery; washing with the cylinder is only rinsing. When the rags are sorted, let them be steeped in kelp or barilha ley, for twelve hours; wrung or pressed and washed, again wrung and wetted with ley, then laid two inches thick upon frames in a steam apparatus, and submitted to the vapour of the ley in which they were first steeped, at the temperature of 250°. This process relaxes and opens the fibrous texture of the threads, and the water in the mill entering them carries off the dirt and colouring matter. If the most beautiful whiteness is required, immerse them in oxy-muriate ley, wash and immerse in acidulous water, wash and beat them into pulp. If the rags are so small that they may be in danger of being lost in the mill, they may be confined in coarse nets. Refuse of tow from flax-mills or hackles, may be prepared for fine paper by a similar process.

Oxy-muriates must be used in discharging the colour from coloured rags, and ink from written paper; even printed paper has been bleached by the alternate use of the alkaline ley and the blanching liquid; for this purpose, I recommend an engine resembling the engines in use, but with a cylinder of wood. The axis may be of wood, or of glass run upon lead, and secured with leather collars. The case provided with a steam-tight cover. The

* Murray's System of Chemistry, vol. 2, p. 565.

rags when beaten into pulp with the steel roller, are to be run into the wooden engine, into which the oxy-muriatic vapour is to be forced from a small apparatus for the purpose. The motion may be given to the wooden cylinder by hand, which will sufficiently agitate the water and the pulp, so as to expose different surfaces to the action of the vapour. The pulp may then be allowed to subside, the water run off and acidulous water run in, agitated and washed as before. The pulp will then be freed from every thing injurious to the paper. If an apparatus for preparing the oxygenated muriatic acid is inconvenient, the bleaching salt and oxy-muriate of pot-ash can be procured from the vitriol manufacturers at a lower rate than private individuals can prepare them for their own use.

In bleaching cloth, rags, or pulp, with oxy-muriate of pot-ash, the stuffs must be made to pass through acidulous water, that the sulphuric acid may expel the oxy-muriate from its combinations. The alum used in the size for writing paper, will in some measure have this effect. The small quantity of alumine, or of a selenitic compound precipitated, will not have a bad effect on the paper. When oxygenated muriatic acid combined only with pure water is used, washing well, and exposure to the air and light may be sufficient.

This method points out the means of preparing expeditiously and economically, the coarsest tow, the brownest and the dirtiest rags and cloth, being made into the best and whitest pulp for paper.

NOTE.—For additional remarks on bleaching, and the process by which it is conducted at Manchester, see Domestic Encyclopedia. ED.

EXPERIMENT OF ROTTING HEMP,

AGREEABLY TO MR. BRAALLE'S METHOD.

IN the first number of the ARCHIVES, mention was made of a public experiment by M. de Liancourt, of rotting hemp, agreeably to the process of Mr. Braalle: the following account of the experiment is given by himself in a French Journal—*Annales de l'Agriculture Française*, tome xxii. p. 289.

The government, in diffusing through the departments, instructions to rot hemp in two hours, by Mr. Braalle of Amiens, and in all seasons, invited proprietors to repeat those experiments, the success of which he had ascertained, by repeated trials during four months, as one of the commissioners named by the government.

M. de Liancourt thought it his duty to attend to this benevolent call: the success of the method of Mr. Braalle, was of great importance to the country in which he lived, (Liancourt, department of Oise) where hemp is extensively cultivated, and where consequently, the rivers, brooks, and marshes were infected during two months of the year, and obstructed during the remainder, by the common method of rotting hemp, and where the women upon whom this task falls, (and they are almost all so employed) are subject from that work to accidents, and to frequent diseases, which bring on premature old age.

But however well convinced M. de Liancourt might be of the excellence of this method, attested by the report of the commission, it was necessary to convince those of its superiority, for whose benefit it was principally designed, and who attend with great reluctance to every project that is new to them, chiefly in rural matters, in which the usual methods are always, in their opinion, the best, and which they think cannot be changed for the better, without the imputation of insanity.

It was necessary, moreover, in making the experiment before the country people, to show to them its easy practicability, its cheapness, and the simple apparatus it required.

M. Molard, who had been one of the members of the commission, charged with the experiment of Mr. Braalle's method, was consulted; this friend to arts and the public welfare, was not contented with giving his advice by letters, but wished to come and preside at the essays of Mr. Liancourt: he did more, he brought to Liancourt, Mr. Braalle himself, the author of the discovery.

All the women of the district were invited to witness the experiment; the judge, and the mayor were also invited. It was necessary to give to the success of the experiment, all the authenticity which circumstances would admit of, and which could only produce the desirable conviction,—a conviction indispensably necessary to produce in that country all the good which was designed.

Here follows the process:

A farm kitchen was the laboratory: the common kitchen boiler was filled with 107¾ kilogrammes, (220 lbs. French) weight of water, in which 48 grammes (12 oz. French) of green soap were dissolved: ten kilogrammes and three-quarters, (22 lbs. French) of hemp were to be rotted. The imperfection of the apparatus, and the uncertainty of the quantity of soap, inclined Mr. Braalle to think it was proper to increase the soap a little more than usual; when the water had attained the 80th degree of Reaumer's thermometer, it was poured out into a bad bathing tub, in which the hemp was laid horizontally and pressed with stones, in order to effect the entire immersion; the bathing tub was covered with planks and linen cloths, to confine the heat, and prevent evaporation as far as the imperfect apparatus would permit.

Two hours afterwards the hemp was taken out of the tub; and some handfuls distributed among the women; they examined it while very hot, and found it so perfectly rotten, that they could peel it with the greatest ease. The rest of the hemp was put to dry and covered with nets.

The experiment was renewed immediately on the same quantity of hemp; the soapy liquor left in the tub was again returned to the boiler, and three buckets of fresh water, thirty-six gram-

mes (9 oz. French) of soap were added, and they proceeded with the same success as at the first trial.

This was not enough: the hemp might be apparently well rotted, but it might be said to be less fit for domestic purposes than the hemp rotted agreeably to the old method, if the objection had not been anticipated by the proprietor, in proposing to submit the hemp so rotted to the subsequent operations, such as drying, breaking, combing, spinning and weaving; and to convince all the witnesses of those successive operations, even by their participating in the work, if they chose. The hemp dried and cool under the nets was spread on billets of wood, and lightly broken by a stone roller. It was then spread on the grass to be whitened, but by the carelessness of the men charged with that operation the complete success was checked; the hemp ought to be put on grass, exposed in the pure air, and to the sun, but it was placed near a stack of oats between two buildings, and on grass too often frequented by fowls: it could not therefore whiten completely. Some parts entrusted to country women, and exposed in a good place, whitened perfectly. The other operations which the hemp had to undergo, succeeded intirely, and it was acknowledged at the combing, that it gave less shaws than the hemp rotted in the common way; that the shaw itself was stronger than the heart of the common hemp; and that the filaments of the heart of the hemp were incomparably finer, straighter, stronger, and less twisted than those of the heart rotted according to the old method.

The superiority of the thread extracted from this hemp, ought to be, and was in reality the consequence of that operation: every woman who spun it, and there were upwards of thirty undertook to do so, found the thread more easily spun, and acknowledged that it was stronger than the common thread: the thread of the shaws itself, was acknowledge to be equal in quality to the thread of the heart of the common hemp.

The operation of peeling was attended with the same success: and it was also acknowledged that both the cloth of the shaws, and that made from the heart of the hemp, woven by the same person, without any additional care, were superior to that made with thread from the shaws and heart of hemp rotted according

to the old method, and consequently there is no doubt, that the hemp rotted agreeably to the new method, (quantity being equal) will produce a greater proportion of cloth, than hemp rotted in the old mode, because the filaments are straighter, stronger, more pliable, and the proportion of shaws is considerably less.

Besides the advantages already mentioned* of the new process, M. de Liancourt adds, that it preserves the filaments of the hemp in all their strength, and renders the operation of rotting more certain; since every inhabitant of the country knows that in the old way, if the hemp be left in the water twelve hours longer than necessary, it very often takes on a putrefactive ferment, and that the rains, or farm work, more immediately pressing, often causes such a delay.

Another consideration of national importance, is the facility that the new method of rotting gives, of cultivating hemp in all soils capable of producing it, whereas at present, the culture of hemp is confined to soils in the vicinity of water. Besides it happens very often, that in very hot summers the waters of the marshes and creeks which are used for rotting hemp, are exhausted, and the farmers who have grown hemp are obliged to carry it to water in remote places, sometimes three and six miles, which causes a great loss of time and extra expense in the hire of hands, for the apparatus for preparing it, and for the permission to use the water.

MISCELLANEOUS OBSERVATIONS ON SHEEP.

Additional weights of fleeces of long woolled sheep in Virginia: also of Mr. Livingston's flock: correction of errors respecting it in the first number of this work.—Woolliness of Merinos' legs.—Utility of salving sheep.—Account of sales of Merino sheep in Philadelphia.

IN the first number of the Archives, p. 70, 73 and 124, the weights of several fleeces of American sheep were given, in order to show the capability of improvement in our flocks, and the

* See also, Archives, No. 1, p. 64.

improvement which had actually taken place in certain districts. The following additional facts will serve as further encouragement to improvers.

In May 1809, Mr. Alexander Stuart, of Beverly, Somerset county, Eastern Shore, Maryland, sheared five sheep, the weights of whose fleeces were as follows. They were the lambs of the preceding year.

No. 1.	10¼ lbs.
— 2.	9 „
— 3.	8¼ „
— 4.	8¼ „
— 5.	8 „
	43¾ lbs.

At the sheep shearing of Mr. Custis, of Arlington, Virginia, in April 1809, the following sheep were shorn.

Columbus, a tup lamb, by Mr. William Fitzhugh, of Ravensworth, Virginia; weight on hoof 130¾ lbs.—weight of fleece washed, 5 lbs. 5 oz.

Horn Took, a tup lamb, by Dr. Wm. A. Dangerfield, of Notley Hall, Maryland, weight on hoof 132 lbs.—weight of fleece, unwashed, 8 lbs. 9 oz.

Palafox, a tup lamb, by J. Scott, Esq. of Strawberry Hill, Virginia, weight on hoof 163 lbs.—wool, unwashed, but very cleanly kept, 5 lbs. 13 oz.

Two ewes, by W. H. Foote, Esq. of Hayfield, Virg., weight of one on hoof, 91¼ lbs.—fleece, unwashed, 7 lbs. 3½ oz.—of the other, on hoof, 92 lbs.—fleece unwashed, 6 lbs. 14 oz.

In page 91, of the ARCHIVES, No. 1, I stated on the authority of a gentleman who had lately been at Mr. Livingston's, that the Merino tup, Rambouillet, weighed at the last shearing (1810), 155 lbs. Mr. Livingston informs me, this is a mistake; he only weighed 145 lbs.; it was another ram, Clermont, that weighed 155 lbs., with his fleece. Thus, at two years old, he was heavier than his sire, a first rate imported Rambouillet ram. It is to be understood, also, that the weights of Clermont and the other two

rams, in 1809, (as stated in p. 91 of the ARCHIVES, No. 1, from Mr. L's book,) were taken after being shorn. Another of Mr. Livingston's stock rams, Jason, a shearling, in the presence of two hundred witnesses, yielded the present season, a fleece of 11 lbs. 12 oz. This, as justly remarked by Mr. Livingston, "is extremely satisfactory, since it shows we have already brought in this country, the Merino sheep to as great perfection, as they have attained in Britain. Mr. Tollet's heaviest ram's fleece being exactly the same with mine."

I have also stated, page 89, the average weights of the ewes' fleeces of Mr. L's flock, at from 4 to 5 lbs.; this however only referred to the half and three-quarter bloods; the average of twenty-seven, $\frac{7}{8}$ bred ewes, and of seven full bred ewes, which was 5 lbs. 2 oz. was overlooked. Mr. Livingston informs me, the lightest ewe fleece weighed 3 lbs. 7 oz., and the heaviest 8 lbs. 12 oz. The average of fleeces of his full bred ewes, lambs included, was 5 lbs. 13 oz.; that of all his ewes to the number of more than two hundred, half bred included, was upwards of 5 lbs. 2 oz.; a weight which he considers, and very justly, as a noble yield, and very encouraging to those who seek for quantity as well as quality of wool, and especially when it is considered, that nine tenths of the ewes had lambs.

Mr. Livingston adds,

"Having given the general average of my ewe flocks, permit me now to present you with a view of some selected ones, not kept up to be shorn, but running with my flock, and having lambs at their sides. The greatest number you have exhibited, (in the ARCHIVES, No. 1,) from one flock, is eight long woolled ewes from Col. Tayloe. These are indeed fine sheep; but still inferior even in quantity of wool, to the same number of Clermont Merinos. Eight of his ewes gave 62½ lbs. of wool. All mine were weighed, and booked in the presence of two hundred witnesses; the wool in the yoke, but free from tags, and the sheep as clean as it was possible for unwashed Merinos to be, having been littered all winter, and kept in clean grass grounds at all other times, and having been besides washed by the heavy rains which fell every day for a fortnight together, till five or six days

before they were shorn. The weights of eight of mine under these circumstances were as follows:

No. 1.	weighed	-	-	-	-	8 lbs.	12 oz.	
— 2.	„	-	-	-	-	8 —	6 —	
— 3.	„	-	-	-	-	8 —	4 —	
— 4.	„	-	-	-	-	8 —		
— 5.	„	-	-	-	-	8 —		
— 6.	„	-	-	-	-	7 —	14 —	
— 7.	„	-	-	-	-	7 —	14 —	
— 8.	„	-	-	-	-	7 —	12 —	
						64 lbs.	14 oz.	

Average . . . . . 8 lbs. 1 oz. 15 pwt.

The average of twenty-four selected from Col. Tayloe's flock was a little better than 5 lbs. The average of all my full bred ewes taken collectively, was 5 lbs. 13 oz.; and that of my whole flock, of upwards of two hundred ewes, exceeded by some ounces Col. Taloe's twenty-four. The average of half my flock, including the four rams, was 7 lbs. 10 oz.—this average struck upon upwards of one hundred sheep. The average of one third of my full bred and seven-eight bred ewes, was 7 lbs. 3 oz. 12 pwt. The average upon one third of my three-quarter ewes only, 6 lbs. 11 oz. 12 pwt. It is obvious then, that if I were now to part with half my ewes, retaining only the best, that my fleeces would be as heavy as Mr. Tollet's celebrated flock of full bred Merinos; and that if I was to cull out of my present number, seventy of the best ewes, that their fleece would average seven pounds, which, considering the difference in the degree of cleanliness between mine and the sheep at Rambouillet, would bring them very near to a par: for Mr. Lasteyrie says, they had not yet attained collectively to 8 lbs. And yet the sheep of Rambouillet are acknowledged to be superior to any in Europe, so much so, that Mr. Delessert in a letter of the 9th February last, mentions to me, that prime rams from that flock, were sold at 1500 francs, (300 dollars). While other prime blooded Spanish Merinos, only sold at from 200 to 300 francs. Lest those who have not seen my sheep,

should suppose that these heavy fleeces are inferior to the lighter ones of other flocks in quality, I need only observe, that the Rambouillet fleeces, from which mine are derived, are the finest in Europe. That my wool has sold constantly to manufacturers at two dollars per pound in the yolk, and is purchased with great avidity. To you sir, who have seen samples of it, I need say nothing on this subject, since you are well satisfied of its superiority. And in the letter you did me the favour to write, July 2d, 1809, you say, that you have shown the specimens to the members of the Cattle Society, and that it was agreed that none of you had seen such beautiful samples; and you add, "the staple is double the length of Col. Humphreys' ram which I had two years, and had a silkiness and wavey appearance which the other is intirely deficient in."

The following statement will serve to show the quantity of provender consumed by five Merino three-quarter wethers in England, and their consequent increase in weight. The sheep were exhibited at the Cattle Show of Lord Somerville, in March last, in London; and had been fed by Morris Birkbeck, a well known respectable agriculturalist.

Weight, Nov. 30, 1809, - - -	537 lbs.
„ March 2, 1810, - - -	670 lbs.
Increase,	133 lbs.

	Cwt.	qrs.	lbs.
Having eat, of hay, - - -	10	3	2
turnips, - - -	21	1	20
100 oil cakes, - -	2	2	20

Notice has been taken by Mr. Dupont, of the remark I made, p. 87, "that Don Pedro has very little wool on his legs." The present deficiency in that respect, observable in him, he ascribes to his great age, and says, that when younger he was clothed down to the hoof, that his progeny carry the same mark, and that he thinks it characteristic of true thorough bred stock. It is a fact however, that Mr. Smith's ram had but little wool on

his legs, and yet that the highest price was offered for his fleece by a manufacturer; and further, that the progeny of Merinos of the same cross, differ much in the proportion of wool on their legs. This remark I have often made when examining my own flock, and that of others. It may be well to attend to the circumstance, in order to determine whether there be any absolute connexion (in the full blood) between very woolly legs, and quality of fleece.

The following account, from the *Virginia Argus*, of the utility of salving sheep, is recorded as confirmation of that practice recommended in the first number.

Mr. PLEASANTS.—I have long thought of communicating to the public, a remedy for the cure of the rot and scab in sheep, which I have made use of with very great success. In the year 1806, my flock was so very indifferent, that from ninety sheep, I sheared only 130 weight of wool, so sorry as to be barely fit to make clothing for young negroes. Immediately after shearing I made use of the following mixture:—Three gallons of tar, and three gallons of train oil, boiled together, to which were added three pounds roll brimstone, finely powdered and stirred in. This quantity was sufficient for the above number, and was poured on with a kitchen ladle, from the top of the head along the back bone, to the tail.

At the next shearing, (in 1807) from seventy-eight of the same sheep, I sheared 360 lbs. of very good wool, and instead of twenty to twenty-five sorry lambs, commonly raised from my flock, I raised fifty-five as fine as ever I saw. Since this application, I have frequently been asked by my neighbours where I got such fine sheep. This remedy was taken from an old eastern paper, which I am sorry to say, I have lost or mislaid. It may be necessary to add, that I have continued to make use of this application with the same success, and that when train oil is difficult to be had, any kind of grease, such as is used for plantation leather, will answer. I am Sir,

Your obedient servant,

J. NELSON.

Mecklenburg, 13th June, 1808.

REMARK.—The quantity of the salve put on in the above instance, was certainly greater than requisite, and must have stained the wool to a great degree, so as to lessen its capability of receiving delicate colours. Butter, and tar or wax, are much preferable.

On Wednesday, 5th Sept. 1810, at the Merchants' Coffee House in this city, at one o'clock, commenced the sale of twenty-five Merino Sheep, advertised to be sold by Messrs. Freeman & Passmore. The concourse of people that attended was greater than is remembered on any similar occasion.

The sale continued two hours, during which time the whole flock, consisting of nineteen Ewes and six Rams, were sold at the following prices:—

No. 1	Ram,	- - -	$200	No. 14	Ewe,	- - -	$400
2	„	- - -	280	15	„	- - -	235
3	„	- - -	370	16	„	- - -	360
4	„	- - -	315	17	„	- - -	140
5	„	- - -	300	18	„	- - -	250
6	„ sick	- -	140	19	„	- - -	185
7	Ewe	- - -	120	20	„	- - -	165
8	„	- - -	200	21	„	- - -	160
9	„	- - -	230	22	„	- - -	105
10	„	- - -	190	23	„	- - -	255
11	„	- - -	255	24	„	- - -	350
12	„	- - -	375	25	„	- - -	150
13	„	- - -	230				

The average price of the healthy rams appears to have been 293 dollars each, and the average price of the ewes 229 dollars and 31 cents. Total amount of the sale of 25 Merino Sheep 5900 dollars.

Another cargo has arrived since the above; and were sold at private sale. Thirty-three ewes brought 250 dollars each. Mr. John Warner and Messrs. Dupont and Bauduy purchased eleven ewes and two rams: the latter at 350 dollars each.

Three rams were sold to Mr. John Wright, and seventeen ewes. Five were reserved for a person in New-York.

From the Agricultural Museum, of Georgetown, Maryland.

Extract of a Letter from CHANCELLOR LIVINGSTON, to Mr. CUSTIS, of Arlington, dated 29th June, 1810.

My sheep shearing this year offers the following curious and encouraging facts:—

The average of the fleeces of my three stock rams, was upwards of nine pounds fourteen ounces; and one of them weighed 11 lbs. 11 oz. which sold at two dollars per pound, as it came from the sheep's back. I believe the United States have never before witnessed a fleece that sold as this did, at more than twenty-three dollars. The average of the ewes' fleeces, the whole number being 196, was equally interesting, as you will see from the following statement:—

		lb.	*oz.*		*lb.*	*oz.*
Half bred ewes averaged		5	1	heaviest fleece,	8	
3-4 do.	do.	5	3	heaviest fleece,	7	9
7-8 do.	do.	5	6	heaviest fleece,	8	4
Full bred,	do.	5	13	heaviest fleece,	8	12

From this it appears, that the weight of the fleeces is proportioned to the purity of the blood, and that in crossing with these sheep we not only gain in the value of the wool, but in its quantity, which I am told is more an object in your state than the quality. If so, cross your long woolled ewes with Clermont Merino rams, and I am persuaded that you will add to the weight of their fleeces.* The next thing worthy of observation is the improvement on my stock since the last year; the average of my full bred ewes was then only 5 lbs. 2 oz., this year they have gained nine

* This will certainly be the effect. But the difference in the nature of the long or combing wool, and the short or carding wool, which is particularly adapted for clothing, should be kept constantly in view. The improvers in England, from a conviction of the importance of keeping the two breeds separate, constantly have crossed the Merino with the short woolled native stock of the country. Such is the Ryeland breed of Herefordshire, upon which Dr. Parry, Mr. Tollet and others have formed their excellent flocks. See Archives, No. 1. EDITOR.

ounces per head, though the keep was exactly the same. I attribute this to two causes, first to the better selection of rams, which I am now able to make, admitting none to my flock that are not very fine, and that yield less than 9 lbs. of wool;—and next, to the general improvement occasioned by keeping and climate, for it is upon the young ewes that the gain is most—the old ones remaining as they were last year. A third inference from these facts is, that it will be very practicable to have a flock of ewes, whose fleeces shall average at least 8 lbs.; for if some give 8 lbs. 12 oz. and several 8 lbs., there can be no doubt that when I begin to select my ewes as I do my rams, and sell those that have the lightest or coarsest fleeces, I may bring them to 8 lbs., which is about the standard of the Rambouillet flock, and more than the double of the flocks of Spain. It is by this mode of procedure that the flock of Rambouillet is so very superior to the Spanish flocks, both in the quantity and the quality of the wool. What will be the state of our manufactures when your farmers, instead of a few ragged sheep, keep flocks of 1000 Merinos, which any farm of 1000 acres may conveniently do? And let me add, what will be the difference in the circumstances of the farmer, who receives 16000 dollars a year for his wool, with less expense than it costs him to make 1000 dollars by his tobacco?

ON THE ESSENTIAL QUALITY OF WOOL, AND ITS DIVISIONS.

When the fleeces are separated from the back of the sheep, they are found to contain different kinds of wool, frequently suitable to the fabrication of articles very dissimilar in their nature, and adapted to processes in the manufacture of a description totally different from each other. The chief business of the stapler is to separate the portions of this mingled mass, to distribute them in their proper order, and to supply the manufacturers with the peculiar kind of wool required by the goods which each of them makes.

Various names are given to wool, according to its state, or relative degree of fineness. When first shorn, it is termed a *fleece;* and every fleece is usually divided into three kinds, viz. the *prime*

or *mother-wool*, which is separated from the neck and back; *seconds*, or that obtained from the tail and legs; and the *thirds*, which is taken from the breast and beneath the belly. This general classification of wool corresponds with the Spanish method of sorting into *Refinos*, or prime; *Finos*, or second best; and *Terceras*, or inferior sort: but the wool-staplers in the eastern part of England, distinguish not less than *nine* different sorts, that are broken out of small fleeces, the names given to which prove the nice discernment of the persons employed. They are therefore, subjoined for the information of our readers.*

"No. 1. Is *Short-coarse*, and very descriptive of its character.

"2. *Livery*, } old sorts into which the fleece was formerly
"3. *Abb*, } divided.

"4. *Second*.—Probably a second or better *abb*, and the first altering in the mode of sorting; which arose either from the improvement of fleeces, or in the art of breaking them. This, and all the subsequent names seem to have been in their regular succession at the top of the list.

"5. *Downrights*.—Perhaps intended to convey the idea of superlative perfection.

"6. *Head* or *chief*.

"7. *Super-head*.—An advance upon the preceding sort.

"8. *Picked Lock*.—First made, perhaps, in small quantities.

"9. *Choice Lock*.—Still more excellent.

Besides these sorts, there is another, recently introduced into the list, and called *Prime Lock;* which, as its name indicates, is the finest possible that can be obtained.

The names of the others are derived from these; and the sorts which they represented are introduced into those parts of the scale where the divisions of it were sufficiently wide to admit them. They are described as a Better Livery, Small Abb, Best Second, and by other epithets of the same kind. This catalogue of sorts rises according to the hair or fineness of the pile, and is calculated to receive that portion of the fleece which is adapted to cloths of the lighter colours; and in order to receive what is suit-

* For these interesting distinctions we are indebted to Mr. Luccock's valuable treatise on "The Nature and Properties of Wool," 12mo. 1805, p. 142.

able only to the stronger tints, we run parallel to it a list of sorts usually denominated Greys, of the first, second, and third order. The French manufacturers, who are sometimes very exact in their mode of sorting, particularly for the more delicate branches of the manufactures, have been recommended by M. D'Aubenton to make use of a micrometer, in order to ascertain the size of the hair with more perfect nicety. The pile of my own sorts, when examined by means of a lens applied to a graduated scale, generally arranges itself within the following dimensions. The Breech or Short coarse, receives all the short and very inferior locks, and the Livery, those of a finer kind; but with a considerable latitude of hair. The diameter of the pile in all the others will be represented if we divide an inch, which we consider as unity, by the number annexed to each of the names.

Better Livery by six hundred.
Fine-Grey — seven hundred and twenty.
Seconds — eight hundred.
Downrights — nine hundred and twenty.
Head — one thousand.
Super — eleven hundred and sixty.
Picked-Lock — twelve hundred and eighty.
Choice — fourteen hundred.

A sample of moderately fine Spanish wool reached sixteen hundred.

These numbers it is added, are the average of repeated measurements: and are by that able writer considered as the standard of the sorts, to whose names they are respectively affixed.

Whenever therefore a wool stapler buys fleeces, his object is to procure at a given price the largest possible proportion of the superior kinds; fineness of pile being the principal consideration. Thinness of hair can very seldom be regarded as injurious to a fleece; while coarse hair, frequently renders it unfit for various purposes. The following are the principal objects of attention in the present state of the woollen manufactures: viz.

1. The *length of the staple;* for this regulates the various fabrics to which the fleece is destined, and produced by instruments of dissimilar construction, viz. the card and the comb. Thus, in

carding wool, a *short pile*, and a disposition to "assume a crumpled, or spring-like shape, is an object of prime importance." This shrivelling quality, Mr. Luccock remarks, p. 147, cannot prevail in too high a degree; if it be to make cloths requiring a close and smooth surface. But for cloths, where a long and even nap is required, such as blankets and cloths intended for large surtouts, too large a proportion of this curling property he conceives would be detrimental, by rendering the nap less uniform and compact, and consequently a *long* pile or staple will be preferable. Hence it will be obvious to every attentive cultivator, that wool must be grown for particular purposes, according to the nature of the manufactures carried on in his vicinity. There is, however, a certain point, beyond which, if this crumpling quality proceeds, the wool becomes less valuable, on account of the superior length of the curves, which render it difficult to break the staple sufficiently. The distribution of the hairs in this staple has been compared to that of the grain in a very crooked piece of timber, or to waved bars of metal so formed that the convex part of one fits into the concavity of another. As this peculiar property cannot be communicated to wool where it does not naturally exist, breeders of sheep will find it essential to their own interest, to unite the valuable properties of wool with those of the carcase.

2. Pliability of wool is another important quality to which the attention of the grower should be directed; as, without this it will be unfit for the purposes of manufacture. The Spanish wool possesses this quality in an eminent degree. Woollen articles require a great variety in the degrees of elasticity possessed by the wool from which they are made. Blankets, fearnoughts, and shags, require a large proportion of it, but in the finer and thinner fabrics, a great degree of it is injurious, causing these substances to feel hard and prickly. Hence the shears, heated plates under press, and singeing stoves, are employed to form a smooth soft and glossy surface.

3. The peculiar quality, by Mr. Luccock termed the *felting quality*,* is of equal importance with the preceding, and, though not evident to the eye, is in fact indispensably requisite in all

* Treatise on Wool, p. 161.

wools which are wrought up into such cloths as are submitted to the action of the fulling mill. Mr. L. describes it as "a tendency in the pile, when submitted to a moderate heat, combined with moisture, to cohere together, and form a compact and pliable substance." This valuable property is possessed in a higher degree by the Spanish sheep; and, according to Mr. L's opinion, the Cheviot, Morf, and Norfolk [English] fleeces, are best adapted for the purposes of fulling.

[According to Monge, (*Annales de Chimie*, tom. vi. p. 300,) "The felting of wool or hair, is an effect resulting from the external confirmation of their fibres, which appear to be formed either of small lamina placed over each other, in a slanting direction from the root towards the end or point of each fibre, like the scales of fish lying one over the other in succession from the head to the tail; or of zones placed one upon another, as in the horns of animals: from which structure each fibre, if drawn from its root towards its point, will pass smoothly through the fingers, but if drawn in a contrary direction from the point towards the root, a sensible resistance and tremulous motion will be felt by the fingers. This peculiar confirmation disposes the fibres to catch hold of each other, and as they cannot recede when acted upon by a progressive motion, they naturally advance by a similar motion from the end towards the root. Ed.]

4. A soft pile is also an essential requisite to constitute a good fleece. In this, as well as in the other properties already enumerated, the Spanish wool peculiarly excels: and, among the British fleeces, those of Shetland stand unrivalled in this respect.

5. The specific gravity, or relative weight of the pile, is a quality to which the attention of wool growers has not yet been directed so particularly as the subject requires. In order to ascertain the comparative weight of different samples, Mr. Luccock directs each of them to be brought as nearly as possible to the same degree of purity, to expel all the moisture which wool obstinately retains, and extract all the air contained in the interstices of the staple. The importance of rendering wool as light as

possible, is clear to every one who considers that the quantity of cloth, which a given weight will produce, is the true test of its value.

6. The smell of wool is not a property to which much weight can attach, provided no disagreeable odours are emitted, or any of the effects of moisture are exhibited. Mr. L. considers no one scent to be preferable to another. It is, however, essential that wool should, as far as possible, be perfectly *white*.

7. The last property to which the attention of the cultivators of wool should be directed, is "*trueness of hair*," or a uniform regularity of pile, in which no coarse, shaggy hairs are perceptible; as the latter, by reason of their brittle nature, will very materially affect the progress of the manufacturer. Such coarse hairs, as well as kemps or stichel hairs (which are generally short, brittle, pointed, opaque, and of a grey or brownish cast,) are found principally in neglected breeds. Since, however, the art of combining the properties of the parent sheep in their offspring has become generally known, the expert cultivator of wool has been enabled to produce surprising alterations in its relative weight and fineness.

Mr. Luccock remarks, that when sheep produce wool sufficiently short to meet the wishes of the manufacturer, the operation of shearing should be deferred, at least if no particular advantage to the animal is to be obtained by clipping it sooner, until the new coat appear like a fine downy substance mingled with the bottom of the staple: for this being shorn with the old fleece renders the pile more suitable to the manufacture of woollen cloths. It is naturally soft, fine, and unelastic; contributes to the delicacy, solidity and strength of the thread into which it is twisted, and can be brought to display upon the surface of the cloth the superiority of its qualities. These remarks being so different from the common opinion, deserve attention from the farmer and manufacturer. They will bear in mind that they are only applicable to the common breeds of sheep, not to the Merino.

ADDRESS OF THE LINNEAN SOCIETY.

Philadelphia, 16*th Aug.* 1810.

DEAR SIR,

AS chairman of the committee, who were appointed by the PHILADELPHIA LINNEAN SOCIETY, to address the citizens of the United States, on the subject of the natural productions used in the arts and manufactures, I have to request you will have the goodness to insert the accompanying address in your "*Archives of Useful Knowledge.*"

I am extremely well pleased with your useful though arduous undertaking; and from the specimen presented to the public (of your first number) no doubt can be entertained, but that your zeal in the cause of science, and every kind of useful information, will receive the sanction and support of the citizens of the United States.

In truth, sir, to appreciate the value of knowledge, is to know its utility; and no means however simple, can demonstrate this fact, more than that of diffusing information through the channel of a periodical work, by drawing such conclusions, founded on its application to the arts or manufactures, which are more immediately adapted to the subject under consideration. To the man of science, the artist and manufacturer, an extensive field presents itself in our country; indeed, where the productions of nature are numerous, and their uses known, their application to *some* useful purpose must follow as a natural consequence; the contemplation of which, would arise not merely from motives to gratify the scientific portion of society, but an absolute conviction, that their utility to our country, in the manufacture of a thousand articles, by adding to our wants and comforts as a people, would relieve us from foreign dependance.

If, then, by introducing matter of so important a nature to the public eye, it will tend, and irresistibly impel, our ingenious countrymen to apply such knowledge at least to the improvement of the arts or manufactures, a great point will be gained. In this light I consider the "Observations on Sheep," published in your first number; and having read them with attention, I can do no

less than remark, that they are particularly calculated to excite, not only the attention of the scientific, but of the agricultural reader. The introduction of so valuable a breed, as the Merino, into our country, is a great acquisition. Every means ought to be taken to facilitate their growth and number, as well as the common breed of our country; for we live in the hope, that ere long woollen cloths will be WHOLLY manufactured within ourselves. The conclusion, therefore, would be, that as our country abounds in the most useful productions of the animal, vegetable, and mineral kingdoms, their application to our immediate wants, will render us independent of Europe, and cause the manufacturing interest ultimately to become that of the commercial.

I am, dear sir,

With sentiments of the highest consideration and esteem,

Your obedient humble servant,

JAMES CUTBUSH.

JAMES MEASE, M. D.

Secretary to the Agricultural Society, &c.

ADDRESS

Of the committee of the Linnean Society of Philadelphia, to the citizens of the United States, on the subject of the natural productions employed in the arts and manufactures.

To every nation, it ought to be an object of the first importance, that it should possess within its limits, the natural productions essential to manufactures and the arts.

A nation, which depends on another for the supply of its necessary wants, or the materials for its labour, cannot be entirely free. It is placed under such disadvantages, that seldom will it dare to maintain its rights against the aggressions of the government which commands its supplies.

A large portion of its citizens, accustomed to consider a foreign nation as the immediate instrument of support, of acquiring wealth, or yielding the enjoyments and conveniences of life, contract foreign partialities and foreign prejudices. They are more connect-

ed and more attached by interest to the government, whose trade maintains, whose manufactures clothe, and whose luxuries enervate them, than to that, which gave them birth, gave them independence, gave them freedom. The short suspension of our commerce taught the American people these truths. It exhibited the inconvenience;—it did more, it exposed the destructive evils of a dependance on a foreign government for goods of daily and domestic use. It proved that to be free, a people should possess not a government and laws of their own only; but, that they must have their own WORKSHOPS. It showed that freedom consists not in a mere exemption from political subjection, but also from moral servitude.

In viewing the present zeal for the establishment and promotion of manufactures, every patriot's breast must glow with virtuous feeling. The contention, for so it may be termed,—the contention for their establishment, is a strife for the independence of the country. The battles of the revolution broke our chains asunder, but they still cling around us; the spirit for manufactures, is now to cast them from us for ever.

To lend their feeble aid in this important endeavour, is the ambition of the PHILADELPHIA LINNEAN SOCIETY; and they believe they can the better accomplish this object, by directing their researches to the discovery, in this country, of those subjects, which, coming under their notice as a society of natural knowledge, are the objects of commerce and the materials of manufacture.

The list of Articles of the Materia Medica of the United States, is already extensive and important. Many of its contents supersede in the practice of our physicians, the drugs of Europe and Asia.* By research and experiments, it no doubt could be greatly enlarged and improved to the advantage of the nation, and benefit of individuals.

Our forests yield some plants, which, as dyes, for brilliancy and permanency of colouring, are not surpassed by any of South America or India; the number is, however, small, and the range of hues confined.

* See Barton's Collection towards a Materia Medica

Our country is prolific of some metals. Yet antimony and mercury are unknown as its productions. Arsenic, cobalt, copper, and the precious metals, have been found in such small quantities or peculiar states, as to render them little valuable or useful.

There can be no reason why all these metals should not exist abundantly in this country. There is every probability they do. The rocks, which are their gangues in other countries, in our own are generally diffused. It is indeed no stretch of credulity to believe that their ores are every day trodden under foot, turned up by the plough or spade, and thrown away or regarded as useless, from ignorance of their value. Similar cases have been known; of which the following may be cited:

Black jack, an ore of zinc, now largely employed in the making of brass, a few years past was used in Wales, for mending the roads; and the cobalt ores of Hesse, which now yield a neat profit of 14,000 pounds sterling per annum, were formerly employed for the same purpose.*

If ignorance should have caused, in Europe, at a late period, such a misapplication of valuable and productive ores, how very probable is it, that in this country, where hardly one in a thousand has a superficial acquaintance even with their appearance, that they may be in the hands of hundreds; may be used for common purposes constantly, and their importance never suspected.

It has happened, that valuable ores have remained unworked, to national and individual injury, from a just diffidence in the proprietors of expending their money fruitlessly, as they could not obtain a knowledge of their nature and richness.

Others again, deceived by appearances or the false representations of designing men, have disbursed considerable sums, and wasted much time in the useless search for metals, when a metallurgist would at once have pronounced that no ore existed, or it was one too poor to be profitable.†

* Watson's Chemical Essays, vol. 1st, page 45.

† This has actually happened. A company was recently formed to work a copper mine, and many thousand dollars expended in the apparatus preparatory to commencing work. Upon examining the ore, Mr. Godon, of Philadel-

To assist, therefore, in obtaining a full knowledge of the medicinal and dying drugs indigenous to our soil; to expedite the discovery of useful metals; to aid the manufactures of their country, as far as they are connected therewith; and to remove the inconveniences and disadvantages of individuals not possessing an acquaintance with natural knowledge, the Linnean Society of Philadelphia has directed the undersigned committee to give this public notice, that any plants, ores, or any mineral substance whatever, which shall be forwarded to any member of the committee, shall be examined by the botanical and mineralogical departments of the society. The result of the examination shall be communicated, as soon as completed, to the person transmitting such specimens, together with such other information relative to its nature and uses, which the society can impart.

JAMES CUTBUSH,
SAMUEL JACKSON,
SAMUEL BENEZET,
} *Committee.*

CHINESE SOY.

THE agreeable flavour which the Chinese and Japanese *Soy* communicates to fish is well known. But the high price of the article confines its use to few persons. Hence it has always been an object to discover the peculiar mode of preparing it. Several processes, particularly those by Professor Beckman, M. Ekeberg, and by Sir Tilloch, have been published; which have been copied into various periodical publications, and Encyclopedias.

It will be seen however, that the following method, carries internal evidence of coming nearer to the truth than any other, and is therefore recommended to our readers. The Editor has the satisfaction to assure them, that the Bean, *Deliches Soyæ*, bears the cli-

phia, persuaded them to abandon the project, the ore being of that kind, which repeated experience in Europe had proved, would not repay the labour necessary to smelt it. EDITOR.

mate of Pennsylvania well: there is therefore nothing to prevent our enjoying the agreeable condiment, of which it is the basis, except our own indifference. Accounts of the trials of the recipe will be thankfully received.

METHOD OF PREPARING THE CHINESE SOY.

By **M.** DE GRUBBENS: *extracted from the Memoirs of the Academy of Sciences at Stockholm for* 1803, *first Quarter, by M.* LINDBOM, *captain of the Swedish Mines.**

THE transactions of the Swedish Academy for the year 1764 contain a description of the method of preparing soy, by the late captain Ekeberg; but as this description is incomplete as well as incorrect, since the real Chinese soy will not be obtained by following it, I am fully persuaded that **M.** Ekeberg never saw, nor was acquainted with, the true process for preparing this substance. There is reason to believe that he gave his description from the accounts of the Chinese, who are not always ready to speak the truth, as I observed during the five years I resided in China, when I wished to obtain complete information in regard to the method of managing a certain kind of silkworm which spins five or six times every year: the method of dyeing silk and cotton, and various other particulars in regard to the Chinese economy.

Having since obtained, for a very high price, certain information in regard to these points, I have seen how much their accounts differed from the truth. The case was the same when I wished to be made acquainted with the preparation of soy; but as I have now procured a very correct account of it, I think it my duty to communicate it to the academy.

Soy is prepared from a kind of beans, which are whiter and smaller than those of Turkey, the farina of wheat, salt, and water. The proportions are, 50 pounds of beans, 50 pounds of salt, 60 pounds of the farina of wheat, and 250 pounds of water.

After the beans have been well washed, they are boiled with well-water in an open pot for some hours, or until they become soft enough to be kneaded with the fingers. During the boiling

* From the Annales de Chimie, No. 148.

they must be always covered with water that they may not be burnt. Care must be taken not to boil them too much: if they are diluted, too much of the substance remains in the juice. When the beans are boiled they are put into large flat wooden tubs, or, as the Chinese do, into vessels made of thin broad splinters of bamboo, two inches and a half in depth and five feet in diameter. In the latter they are spread out to the depth of two inches. When they are sufficiently cooled to be touched with the hand, the farina of wheat is added, and well mixed with them; and this is continued till the whole farina is exhausted. When the mass becomes too dry for the farina to adhere to the beans, a little warm juice is added.

When the whole is well mixed, the mass is spread out in the tubs above mentioned, taking care that the strata are not more than an inch or an inch and an half in thickness. The mass is then covered, by placing over it a lid which exactly closes it. When it is observed that the mass becomes mouldy, and that heat is disengaged from it, which takes place in the course of two or three days, the cover must be raised up, by placing two rods below it, in order that the air may have free access. In the mean time a rancid odour is exhaled. If the mass assumes a green colour, it is a sign that every thing goes on well; if it begins to grow black, the cover is raised a little more, in order that the mass may be more in contact with the air. When the mass becomes completely black it is entirely spoiled.

As soon as it is observed that the whole mass is green and mouldy, which is generally the case in eight or ten days, the cover is removed, and the mass is exposed for some days to the air and the sun.

When the whole mass has become hard like a stone, it is cut into small fragments, which are thrown into an earthen pitcher, and 250 pounds of water, in which 50 pounds of salt are dissolved, are poured over them. The whole is well stirred; and the height which the water occupies in the pitcher is noted. In case one pitcher is not sufficient, the mass is put into several, taking care that each be proportioned to the quantity of the matter.

When the pitcher is thus filled it is placed in the sun. The matter must be regularly stirred and shaken every morning and evening, but at night care must be taken to put the cover on it to preserve the mass from the cold. This cover is made convex on the outside, that the rain may more readily run off from it, and it is employed also in the day-time, when it rains. The greater the heat of the sun, the more the preparation of the soy is accelerated. This operation in general is undertaken only in summer, and yet it continues for two or three months.

In proportion as the mass decreases by evaporation, well-water is added, and this is continued till the salt water has entirely dissolved both the farina and the beans. The pitcher is then left some days longer in the sun, in order that the solution may be so much the more perfect, as on this depends the good quality of the soy, and even during this time the matter must be stirred every day.

When the mass has become very succulent and oily, the whole is poured into bags; which are pressed to squeeze out the soy, which is then pure, and ready to be employed. It is not boiled, as M. Ekeberg asserts. It is then put into bottles, which are well closed. The Chinese, who deal in this article, put it into large pitchers. The soy, before it is squeezed out, is of a dark brown colour, but it afterwards becomes black.

The Chinese prepare from the refuse that remains two other kinds of soy. The first time they add 150 pounds of water and 30 pounds of salt: having squeezed this mass, they again pour over it 100 pounds of water, proceeding always in the same manner as above described.

The last two kinds are not strong, but very salt; especially that of the last extraction, the colour of which is always clear. These two kinds are the commonest in China. The difference between them is as 8, 4, 1.

In the year 1759, I prepared in this manner, in my lodgings at Canton, all the soy which I employed. I even brought some bottles of it to Sweden; it was succulent, oily, moderately salt, and entirely different from that usually sold in Europe: in regard to

its taste it was equal to that of Japan, which is generally considered as the best.

This description is the more certain, as I always executed the preparation myself: I will even venture to assert, that it is that used to obtain soy of the best quality.

M. Ekeberg asserts that the soy is boiled, and that sugar, ginger, and other spiceries are added; but this is void of foundation, and cannot be true, since a Chinese pound of soy does not cost more than two *canderins* Chinese money, which are equal to one and one-third skilling Swedish.* This was the usual price during my residence in China, and there is no reason to believe that these ingredients were employed in the preparation of it. Besides, soy has no taste either of sugar or of spiceries; the prevailing taste is that of salt.

EXPERIMENTS AND OBSERVATIONS

On the saline or fixed ingredients of the Congress Spring, at Saratoga, in a letter from JAMES CUTBUSH *to Dr.* BENEZET, *communicated to the Editor.*†

SECTION I.

Examination of the saline matter of Saratoga.

EXP. 1. TO a sufficient quantity of pure water, I added the powder, and digested it for some time. The insoluble portion was separated by the filtre, and was repeatedly washed. A part of this solution was put into a wine glass, and some of the oxalate of pot-ash was added, which produced no change.

EXP. 2. Carbonate of ammonia, added in the same manner, produced no precipitate.

EXP. 3. Caustic pot-ash had no effect.

EXP. 4. Muriate of barytes gave a white precipitate, insoluble in muriatic acid.

EXP. 5. Sulphate of silver, added in a similar manner, gave a copious precipitate.

* A canderin is equal to about 3 sous and 7 1-2 deniers French money.

† The saline matter upon which these experiments were made, was brought by the publisher from the spring.

Exp. 6. Nitrate of silver had the same effect.

Exp. 7. Tincture of galls produced no change.

It may be proper to remark, that neither litmus nor turmeric paper were changed on immersing them into the solution, which therefore proves, that no excess of alkali nor acid was held in solution. These experiments shew, that the soluble part contained no lime (Exp. 1.), nor, indeed, any earthy matter (Exp. 2 and 3.)

Experiment 4 proves, that a sulphate was held in solution, and, from the former experiments, is an alkaline sulphate. The presence of a muriate was discovered by experiments 5 and 6, and from similar reasons, is an alkaline muriate. Experiment 7 shews the non-existence of iron.

These experiments are conclusive, and determine only the presence of neutral alkaline salts.

SECTION II.

Examination of the part which remained after the affusion of water.

Exp. 8. To a portion of the dry powder, which was of a grey colour, I added some nitric acid: a violent effervesence was produced.

The acid was soon saturated; the solution was diluted with water, and filtered. The insoluble portion, which was exceedingly small, I concluded was silica.

Exp. 9. To a part of the nitric solution, oxalate of pot-ash was added. A precipitate, at first scarcely perceptible, but afterwards copious, was produced.

Exp. 10. Carbonate of potash added to another portion, occasioned a precipitate, which was soluble with effervescence in muriatic acid.

Exp. 11. Caustic potash also produced a precipitate.

Exp. 12. Carbonate of ammonia had the same effect.

Exp. 13. After the addition of carbonate of ammonia, the whole was filtered to separate the precipitate; and phosphate of soda was added to the filtered liquor. A copious precipitate now appeared.

Exp. 14. The precipitate produced by the carbonate of ammonia, in the first instance, was put into a wine-glass with a portion of muriatic acid; an effervescence took place; and the addition of oxalate of potash caused an abundant precipitate.

Exp. 15. Alcohol of galls was added to a portion of the nitric solution, which struck a slight black colour. These experiments, upon the whole, appear to confirm the analysis made by some able analysts, and serve to shew, that the experiments of Dr. Seaman (which we shall afterwards notice) exhibit the solid contents pretty accurately.

Experiment 8, however, indicates the presence of carbonic acid, which was united with the earths, forming sub-carbonates.

You will perceive, Sir, this circumstance evidently proves, that, in obtaining the solid contents of the water by evaporation, the proportion of carbonic acid necessary to hold the earths in solution, was disengaged; consequently, in obtaining the saline matter, the heat separated this portion of carbonic acid, and left the earths, in the form of sub-carbonates, accompanying it.

The addition of oxalate of potash to the nitric solution, is a proof, that lime was held in solution. This fact was also shewn, although in a general way, by Experiments 10 and 11, for these reagents will precipitate all the earths with one or two exceptions.

Experiment 12, shews also the presence of earths; but, however, as the carbonate of ammonia has the property of holding the magnesian earth in solution in the common temperature, the fluid was filtered after adding the ammoniacal carbonate; on the addition of phosphate of soda, in Experiment 13, a precipitate appeared, indicating the presence of magnesia. This precipitate is a triple compound of phosphoric acid, magnesia and ammonia.

Experiment 14, confirms the fact already advanced respecting the presence of calcareous earth. The last experiment discovered the presence of iron.

This section of experiments discovered the following substances: carbonated lime, carbonated magnesia, carbonated iron, and silica.

SECTION III.

Examination of the saline matter by evaporation, &c.

The residue of the solution made with water was exposed to the solar rays, and, when it was sufficiently evaporated, I added a portion of alcohol to a part.

The object of this experiment was to separate the salts, which are insoluble in this fluid, or to ascertain if any existed, in addition to the other experiments. Mr. Kirwan remarks, that when alcohol is mixed with an equal quantity of a saline solution, it will precipitate all the salts it is incapable of dissolving. I will merely add, that alcohol is useful in chemical researches of this nature, in consequence of this property it possesses. It is susceptible of dissolving most of the earthy muriates, some earthy nitrates, &c.; but these were not discovered. In the same manner the sulphates, with one or two exceptions, are incapable of solution.

The turbidness, therefore, which appeared on adding the alcohol, was the alkaline muriate and sulphate in the act of precipitation.

The alcohol was of the standard specific gravity.

Exp. 17. To a portion of the saline matter obtained by evaporation, a few drops of dilute sulphuric acid was added; an effervescence ensued.

On holding a feather moistened with ammonia over the vessel, copious white fumes (muriate of ammonia) were formed.

This experiment also proved, that the saline matter contained muriatic acid.

By a further evaporation of the remaining fluid, until it discovered a disposition to crystallize, and on letting the vessel stand undisturbed, I had the pleasure of observing an immense number of cubic crystals on the following morning, which recognized the presence of muriate of soda or common salt, and especially the presence of soda, the basis of the muriatic salt.

Among the group of crystals, I discovered with a magnifying lens, some small octahedral crystals of a prismatic or cuneiform figure, having two terminating pyramids truncated near their

basis. This crystal may, therefore, be said to resemble the crystal of Glauber's salt; and the sulphuric salt is a sulphate of soda.

REMARKS.

The remarks I have to offer, relative to the observations of Dr. Seaman, though they are general, may, in all probability, be useful; so far, at least, as will enable us to determine the nature of his experiments in relation to my own, especially in forming our conclusions relative to the fixed ingredients of these waters.

The Doctor, in his Dissertation on the mineral waters of Saratoga, second edition, observes, that these waters contain carbonic acid, carbonate of iron, supercarbonate of lime, muriatic salt, carbonated alkali, carbonated magnesia, and a sulphurous impregnation; and that the Ballston water holds in solution carbonic acid, muriate of soda, carbonate of lime, carbonate of iron, carbonate of soda, and carbonate of magnesia.

Considering the experiments here detailed, it would appear, that the saline matter is similar to that pointed out by Dr. Seaman, with the exceptions we shall afterwards relate.

Besides the alkaline neutral salts, of which I have spoken, I have also noticed the presence of the carbonates of lime, magnesia, and iron; all of which were held in solution in the mineral water, by an excess of carbonic acid. In fact, according to strict chemical nomenclature, these substances must exist in the state in which I found them, not as carbonates, but as sub-carbonates. With respect to the muriatic salt, to which the Dr. alludes, it appears, from some of the experiments, and particularly from the crystallization, to be a muriate of soda; and in like manner with respect to sulphate of soda.

The sulphurous impregnation might have been observed at the spring, but then from the circumstance of its ready union with oxygen, the sulphuric acid must have formed; and, in order to facilitate the formation of this acid, it might, in all probability have been disengaged from its subteranean situation in union with soda, forming a sulphuret, which, by decomposition, would con-

stitute a sulphate. This may have been the process of its formation, or, indeed, it might have been produced by the decomposition of an earthy sulphate by carbonated soda.

In conclusion, I may correctly state, that the fixed ingredients are as follows:

Sulphate of soda,
Muriate of soda,
Carbonated lime,
Carbonated magnesia,
Carbonated iron.

I wish much that it was in my power at this time, to examine the water at the place, by which I should be able to discover the quantity of the gaseous contents.

The silica, as it is uncertain whether it originally existed in the water, although it has been detected in mineral waters, I have not put down.

In order to facilitate inquiries relative to analysis, we ought to be in possession of all the facts respecting the subject of the examination; and, more especially, to ascertain the nature and quantity of the volatile as well as the fixed ingredients. I was confined in my experiments, to the examination of the matter obtained by evaporation; one pound of which is produced from ten gallons of water.

I remain, dear sir,

Yours, truly,

JAMES CUTBUSH.

SAMUEL BENEZET, M. D.